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**COLLEGE OF HUMANITIES
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**NATURAL RESOURCES, INSTITUTIONS AND DOMESTIC
REVENUE MOBILIZATION: FROM GLOBAL**

TO LOCAL EVIDENCE

BY

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DECLARATION

I, Daniel Ofoe Chachu, hereby declare that this thesis, except for references to other literature, which have been acknowledged, is the result of my own effort, produced from research undertaken under supervision, and that it has neither in whole or in part been presented elsewhere for the award of a degree.



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ABSTRACT

The quest to mobilize sustainable domestic revenues for financing development is a challenge for many countries, especially those in the developing world. Discovering non-renewable natural resources should therefore be good news. However, the notion of a natural resource curse suggests that countries that are rich in natural resources often perform poorly on several development outcomes. A related term, fiscal resource curse, has emerged. The fiscal resource curse is the inability of countries to raise taxes from a broad base in the presence of non-renewable natural resources. In other words, natural resource revenues displace non-resource tax effort (i.e. mobilization of tax revenues outside the natural resource sector). We take advantage of a new Government Revenue Database (GRD) to examine three key research questions on the relationship among natural resources, institutions and domestic revenue mobilization. For each question, we also examine whether context matters by examining the relationships for the full global sample as well as for developing countries.

First, we examine the validity of a variant of the fiscal resource curse using a more comprehensive dataset which covers not only hydrocarbon revenues but also minerals. We employ a novel instrumental-variable strategy to estimate the causal effect of resource revenues on non-resource tax effort by exploiting the so-called “China shock”. Following her accession to the World Trade Organization in 2001, China’s engagement in the non-renewable resource trade has increased several fold, driving up commodity prices and raising resource revenues among exporting countries. China’s resource trade model with developing countries has been characterized by resource-for-infrastructure deals, which means that exporting countries also benefit from infrastructure projects rather than just liquid capital flows from the exports of natural resources. We exploit this exogenous variation in China’s non-renewable resource trade to examine the causal effect of resource revenues on non-resource tax effect using a Two-stage

Least Squares Approach. We do not find consistent evidence of a negative relationship between resource revenues and non-resource taxes. On the contrary, we find that, once we account for China's role in the global non-renewable resource trade, a percentage point increase in resource revenues as a percentage of GDP leads to about a 0.3 percentage point increase in non-resource taxes as a percentage of GDP. China's provisioning of energy and transport infrastructure in developing countries in lieu of export revenues might be easing the binding constraints to expanding the non-resource sector. The latter becomes the basis for increasing output in the sector and therefore increasing non-resource tax revenues.

Second, the view of the New Institutionalists School is that institutions matter in explaining development outcomes. North (1990) argues that institutions shape the efficiency of markets. Others maintain the view that the quality of institutions shape fiscal policy, even in the presence of natural resources (for example, Masi, Savoia, & Sen, 2018; Botlhole, Asafu-Adjaye, & Carmignani, 2012). Evidence on the mediating role of institutions in improving tax revenues outside the natural resource sector has however been scanty. We investigate whether the type and quality of institutions can mediate the effect of natural resource rents on non-resource tax effort. We begin by proposing a simple theoretical model of social welfare maximization using optimization techniques. The model is characterized by a social planner, who allocates different levels of effort in mobilizing revenues from the natural resource sector and the non-resource sector. The planner determines the allocation of benefits to two main groups in the society: elites and non-elites. These choices are made subject to the total effort and revenue possible to maximize total welfare within the society. A key model prediction is that institutions that focus more on redistribution have a weak moderating influence on the negative effect of natural resource rents on non-resource tax effort, especially when commodity prices are high. Given that the model is limited to looking at the role of only one type of institution, we empirically

examine whether the prediction of the model is consistent by interacting natural resource rents with 12 different measures of institutions commonly used in the literature. Using Fixed-effects Estimators and a Generalized Method of Moment Estimator, we compute marginal effects of natural resource rents on non-resource tax revenues. We do not find a statistically significant impact for a majority of the institutional variables. However, we find a weak evidence of a mitigating effect for two key variables: constraints on executive and the quality of a democracy. The weak impact of these two mediating variables is premised on the fact that, while they play a mitigating role, they are unable to completely undo the negative impact of natural resource rents on non-resource tax revenues. Other covariates that we find important for determining non-resource tax revenues are the level of GDP per capita in an economy, the size of the agricultural sector and the extent to which there is control over corruption.

Finally, following the literature on the differential impact of different types of natural resources on different development outcomes, we distinguish between hydrocarbon resources and non-hydrocarbon resources (metallic and non-metallic minerals) in assessing how they differentially impact on non-resource tax effort. In other words, we test the hypothesis that hydrocarbon-rich countries perform worse in non-resource tax effort than mineral-rich countries. We present a simple theoretical framework of how the exploitation of different types of natural resources yields varying incentives for non-resource tax effort by extending the theoretical framework of Knack (2009). Our theoretical model suggests that hydrocarbon-rich countries perform worse in non-resource tax effort than mineral-rich countries. Discovery of hydrocarbon resources and its exploitation is more likely to be concentrated in the hands of the elite few. Revenues are therefore prone to being expended through rent-seeking behaviour, generous tax incentives and lack of investment in tax capacity. These undermine non-resource tax effort in hydrocarbon-rich contexts compared to mineral-rich contexts where mineral

occurrence is likely to be more widespread and therefore control over its exploitation is likely to be less centralized. We confirm the theoretical results using alternative data sources and alternative panel econometric techniques. In a sample of over 80 countries over the period 1980 to 2015, we find that hydrocarbon rents consistently exert a negative effect on non-resource tax effort. We do not find such consistent evidence for mineral rents nor for mineral-producing countries. This evidence is consistent at the global level and in developing countries.

Our results suggest that government domestic revenue mobilization policy must take into account both local and external factors that contribute to expanding the non-resource sector, reducing informality and diversifying the economy. These factors include providing the relevant development infrastructure (for example energy and transport), improving tax administration and strengthening institutions of state. The quality of democracy, constraints on executive power and control of corruption are some key institutional factors that would be relevant for improving non-resource tax effort. Given that the risks of a lower non-resource tax effort are higher in hydrocarbon-rich countries, the factors described above should be given greater attention there.

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LIST OF ABBREVIATIONS

ADB	Asia Development Bank
CPIA	Country Policy Institutional Assessment
EITI	Extractive Industry Transparency Initiative
GDP	Gross Domestic Product
GRD	Government Revenue Database
ICA	Infrastructure Consortium for Africa
ICRG	International Country Risk Guide
ICTD	International Centre for Taxation and Development
IEA	International Energy Agency
IMF	International Monetary Fund
LIC	Low-income Country
LMIC	Lower-middle-income Country
MDG	Millennium Development Goal
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
UN	United Nations
UNU	United Nations University
WDI	World Development Indicators
WIDER	World Institute for Development Economics Research
WTO	World Trade Organization

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 Background and Problem Statement

An age-old question that has confronted many a policymaker around the world is what viable and sustainable options there exist for financing sustainable development. Consistency in revenue mobilization effort from a sustainable base is key to socio-economic transformation. Several local and international options for revenue mobilization exist. These include taxation, debt, equity, seigniorage, aid and trade. In recent times, the role of remittances and carbon financing initiatives has been highlighted. The viability, effectiveness, reliability, appropriateness and sustainability of these options have been subjected to debate on different grounds (Forstater, 2018; Clemens & Postel, 2018; Arndt, Jones, & Tarp, 2016; Joshi, Prichard, & Heady, 2014; Aryeetey, 2004; Atkinson, 2003). Not even the work of Atkinson (2003) on innovative sources of financing global development through options such as the Tobin tax and a global lottery has garnered consensus.

For example, over half a century debate on the impact of aid lingers on. There are those studies that point to a limited and in some cases adverse impact of aid on an economy (Clemens & Postel, 2018; Deaton, 2013; Moyo, 2009; Knack, 2009; Bornhorst, Gupta, & Thornton, 2008; Easterly, 2006) while others praise its effectiveness and potential (Arndt, Jones, & Tarp, 2016; Arndt, Jones, & Tarp, 2015; Guillamont, 2012; Burnside and Dollar, 2000). In the midst of these debates, Aryeetey & Nissanke (2004) have noted the remarkable attention given to external finance as a means of financing poor developing nations. However, due to severe economic challenges and slow recovery experienced by many developed countries in the aftermath of the global food, fuel and financial crisis in 2008, the reliability of external sources of funding is being increasingly questioned. Moreover, inordinate attention to external sources

of financing could take away from efforts towards exploring innovative sources of domestic revenue mobilization for development.

Building effective states through taxation rather than aid is argued as a more sustainable option for facilitating accelerated development (Besley & Persson, 2014; Osafo-Kwaako & Robinson, 2013; Diamond & Mirrlees, 1971; Kaldor, 1963). The importance of domestic revenue mobilization has been emphasized through the current Sustainable Development Goals (SDGs) – an ambitious global development programme being championed by the United Nations. Goal 17.1 of the Sustainable Development Goals (SDGs) heralds a renewed focus on domestic revenue mobilization, reflecting a paradigm shift beyond dependence on development aid. The latter was a key feature of the Millennium Development Goals (as captured by goal 8) and the Monterrey Consensus. The SDGs offer a more expanded financing framework led by national effort. The accompanying Addis Ababa Action Agenda for financing development reinforces national effort towards building capacity for domestic revenue mobilization while reducing leakages (United Nations, 2015). Several international and regional initiatives are being developed and strengthened to champion this agenda. These include the High-Level Panel on Illicit Financial Flows from Africa, the Global Forum on Transparency and Exchange of Information for Tax Purposes, the Addis Ababa Tax Initiative and the African Tax Administration Forum.

These initiatives are at the heart of the persistent challenges with building fiscal capacity in developing countries. Developing countries are characterized by a large informal sector, weak tax administration capacity and a less diversified economy. The tax base is narrow with undue dependence on natural resources, where they exist. Given the scarcity of economic resources, countries that were endowed with natural resources were thought to have the potential for

increasing incomes and revenues. Or at least so was the thrust of the application of the comparative advantage hypothesis proposed by David Ricardo in 1817¹, as well as the predictions of the Heckscher-Ohlin model. Per this theory, in a simplified two-country model, a country would focus on exporting goods that relied on factors (resources) they were endowed with or cheaply supplied. This should generate export revenue. On the other hand, imports would be informed by the scarcity of factors for or cost of producing importable goods relative to the prices offered by the exporting country. In this way, factor endowments and their relative prices provided a basis for trade.

According to this view, resource-rich countries were likely to benefit from trade through specialization in the production of goods and services that relied on their abundant resource. The evidence, however, suggests that this approach to trade among resource-rich economies has the tendency of neglecting or undermining other potentially vibrant sectors of the economy (Corden & Neary, 1982). The natural resource curse is a term that has been used to describe this phenomenon. The term has been discussed variously and could be defined within the context of evaluating the adverse effect of possessing natural resource wealth on different measures of development outcomes (Edwards, 2016; Botlhole, Asafu-Adjaye, & Carmignani, 2012; Collier 2010; Collier and Hoeffler 2009; Collier and Goderis 2007; Collier, 2007; Sach and Warner, 1995). It challenges the view that abundant natural resources are beneficial to economies. While the concept of a “natural resource curse” has long existed, some attribute its use in the development literature to an article by Richard Auty in 1993 titled, “Sustaining Development in Mineral Economies: The Resource Curse Thesis”. A similar term, “paradox of plenty”, conveys the same idea (Dauvin & Guerreiro, 2017; Karl, 1997).

¹ The hypothesis was not linked to any particular commodity other than explaining the benefits of trade within the context of specialization.

According to the Prebisch-Singer hypothesis, countries that focus on primary commodity exports are exposed to terms of trade shocks as their prices over time are subject to decline relative to manufactured commodities. The hypothesis also follows from theoretical reasoning that the income elasticity of demand for primary commodities (oil, minerals and agricultural commodities) is less than one (Frankel, 2012). In other words, a percentage point increase in global income is associated with a less than one percentage point change in global demand for these commodities. Resource-rich countries, therefore, face volatile prices, volatile revenues and a “structurally skewed” economy that is unable to deliver long term prosperity (Alsharif and Bhattacharyya, 2016).

An important gap that has existed in the literature is cross-country evidence on how natural resources and institutions affect the ability of countries to build fiscal capacity, particularly outside the natural resource sector. This gap has been partly occasioned by the lack of accurate and consistent global panel data on domestic revenues which distinguishes between the natural resource sector and the non-resource sector. Previous research has been limited by this challenge (Prichard, 2016; Prichard, Cobham, & Goodall, 2014; Bornhorst, Gupta, & Thornton, 2009). Attempts to study the effect of natural resources on the ability of resource-rich countries to raise domestic revenues from a broad base is evolving following the development of a new global database in 2014 (see, for example, Masi, Savoia, & Sen, 2018). Masi *et al.*, 2018 describes the deleterious effect of natural resource rents on the ability of resource-rich countries to raise domestic revenues from a broad base as the fiscal resource curse. This dissertation contributes to filling the gap in the emerging literature on variants of the fiscal resource curse.

The New Institutional School contend that evaluation of development policy cannot leave out the role of institutions. Studies on the relationship between institutions and development in general, but also fiscal capacity in particular, have also long been documented (Fosu, 2017; Acemoglu & Robinson, 2008; Acemoglu & Robinson, 2001; North 1990). This includes some meta-analysis (for example, Efendic, Pugh, & Adnett, 2011). For instance, there is the view that pluralistic societies engender tax compliance, state centralization and benevolent welfare outcomes (Acemoglu, Robinson, & Torvik, 2016). Citizens see their payment of taxes as earning them the right to be active in governance and recognized as legitimate parties to a social contract. The nature and quality of institutions should, therefore, impact on non-resource tax effort. The relationship between natural resources and fiscal capacity could be mediated by the underlying institutions. Per the arguments of the New Institutional School, good institutions create the right incentives for improving fiscal capacity even when there are sovereign rents from natural resources. This view however begs the question of how institutions are defined and which types of institutions would be appropriate for translating natural resource rents into improving non-resource tax effort. We explore these questions as part of this research.

Unless otherwise stated, a reference to natural resources in this dissertation focuses on abiotic natural resource materials. These would be non-renewable minerals and energy resources. Per the 2012 United Nations System of Environmental-Economic Accounting (UNSEEA) framework, mineral and energy resources would include oil and natural gas resources (hydrocarbons), coal and peat resources, metallic mineral resources² and other non-metallic mineral resources (e.g. diamond, natural gemstones and gypsum). The UNSEEA distinguishes abiotic natural resource materials from biotic materials. Biotic natural resource materials

² Will include both ferrous metallic minerals such as iron ore, manganese, bauxite, zinc and non-ferrous metallic minerals such as, gold, silver, copper, platinum, tin and lead.

usually refer to renewable resources in agriculture, forestry and fisheries while abiotic resource materials are mostly non-renewables, which are the focus of this dissertation.

1.2 Overall Objective and Research Questions

The overarching objective of this work is to examine the relationship between natural resource revenue and domestic tax revenue effort outside the natural resource sector. The latter is referred to as non-resource tax effort. It represents the ability of a country to mobilize taxes from a broader and more sustainable base. The study investigates the global evidence and then transitions from a global perspective to defined local contexts in the developing world. An important reason for looking at the evidence for developing countries is because natural resources constitute a significant share of their national output. Considering the well-acknowledged role of institutions in development, the study examines the intermediary role of the quality and types of institutions to see if they influence the relationship between natural resources and non-resource tax effort.

Acknowledging that there is a diverse base for natural resources, the study defines two classes of natural resources (hydrocarbons and non-hydrocarbon minerals) and examines their differential impact on non-resource tax effort. Thus, the specific research questions informing the overall objective for this dissertation are as follows:

- What is the relationship between natural resource revenues and non-resource tax effort?
Do natural resource revenues compromise the ability of a fiscal system to mobilize non-resource taxes (displacement effect)?
- Do the type and quality of institutions mediate the relationship between natural resource rents and non-resource tax effort? What types of institutions are more important?

- Does the type of natural resource matter in its impact on non-resource tax effort? How well do hydrocarbon-rich countries perform in non-resource tax effort relative to mineral-rich countries?

1.3 Justification for the study

Globally, there are significant demands for financing the provision of public goods. This demand is more evident in developing countries, where there are deficits in infrastructure, sustainable energy supply, water, education and health services, among others. Improvements in the provision of these public goods and services could potentially serve as catalysts for the socio-economic transformation of these countries. For instance, the United Nations estimates the annual infrastructural gap in developing countries to be about \$1 trillion to \$1.5 trillion (United Nations, 2015). A more recent study suggests an annual estimate of investment needs in developing countries of between \$1.6 trillion and \$2.5 trillion from year 2015 to 2030 (United Nations, 2019). This estimate is against an actual expenditure of about \$870 billion.

Furthermore, recent estimates for Africa based on an African Development Bank report puts the figure at \$130 - \$170 billion per year, with a financing gap of between \$68 billion and \$108 billion per year (African Development Bank Group, 2018). Thus, in a world of fiscal constraints, the appeal of natural resource wealth is one many developing countries will welcome. This is exemplified by recent efforts by newcomers in the hydrocarbon mining industry – Kenya, Tanzania and Uganda – to make the most of their new finds. These countries ultimately look forward to new inflows that should widen the fiscal space to providing the needs of their citizens. The expectation is that revenues from royalties, direct taxes and other potential sources related to the new finds should increase the total resource envelope, in addition to revenues from outside the natural resource sector. However, the key question is

whether natural resource revenues play a complementary role in mobilizing other sources of tax revenue.

While revenues from natural resources may expand the fiscal space for investing in public goods as well as other critical sectors of a resource-rich economy, this is not automatic. The challenges associated with mobilizing natural resource revenues are sufficiently documented (see for example International Monetary Fund, 2015; Daniel, Keen, & McPherson, 2010). For instance, the requirements for an appropriate and effective institutional framework for effectively harnessing the resources does not necessarily or sufficiently tackle exogenous factors such as the volatility associated with commodity prices. Furthermore, there are significant differences between different types of natural resources and the managerial challenges they present. The differences include the type of production contracts applied, industry practices, benchmark pricing for commodities and the fiscal regime applicable (Readhead, 2018). These dynamics, including the capacity to manage the value chain associated with each type of resource, impacts on the revenue outcomes for any jurisdiction. Several other factors warrant the need to look at the extent to which natural resource revenues complement other domestic tax outcomes.

First, the natural resources discussed here are non-renewable and hence have a limited time and scope of availability. Secondly, they are not necessarily irreplaceable nor impossible to substitute in the face of the fourth industrial revolution characterized by fast-changing technology. Thirdly, in the case of hydrocarbons and other metals, there has been an increasing concern over their impact on the environment. Despite the United States of America's government pull out from the 21st session of the Conference of Parties of the United Nations Climate Change Agreement enacted in November 2015, the momentum towards promoting

low carbon emissions has not abated. Moreover, two-thirds of global investments in energy are targeted at renewables (International Energy Agency, 2017). These developments to explore and promote alternative energy sources have been catalyzed by their falling prices, from solar panels and batteries to wind energy technology. Another contributory factor is the level of increasing competition to produce these goods.

According to the 2017 World Energy Outlook, cost of solar photovoltaic cells has fallen by about 70 percent since 2010. In addition, the cost of wind and battery technology have fallen by about 25 percent and 40 percent respectively (International Energy Agency, 2017). Moreover, the largest deposit of lithium in the world is located across the deserts of Chile, Argentina, and Bolivia (Barandiarán, 2019). Exploitation, value addition and innovation around this rare earth mineral is expected to spur improvements in battery technology and are likely to further reduce dependence on fossil fuels. The implication of these developments for hydrocarbon-dependent countries is that alternative sources of tax revenues must be explored in the near future to avert fiscal shocks.

Furthermore, the 2017 IEA report indicates a higher growth in solar capacity than any other form of energy generation. China's unprecedented shift towards cleaner energy is further acknowledged in the report. Based on a predictive analysis, the shift towards low carbon energy is likely to boost demand for minerals and metals to feed the renewable energy industry (World Bank Group & EGPS, 2017). The likely commodity leads are bauxite, cobalt, copper, iron ore, manganese, lead, nickel, lithium, silver, platinum group of metals and rare earth metals. While oil demand is expected to continue to grow up until 2040, the International Energy Agency projects a steady decline in the trend. This is confirmed by the 2017 World Oil Outlook, an official publication of the Organization of Petroleum Exporting Countries (OPEC). The report

attributes the projected decline in oil and gas demand to anticipated improvements in energy efficiency, decline in population growth and income growth and a ‘tightening’ in global energy policy (for example, promotion of policies on carbon emission reduction). The OPEC report is however more bullish about its projections of global oil and gas demand, albeit emphasizing a declining trend in the five years leading to 2040 (OPEC, 2017). Furthermore, the report tampers its optimism with concerns about uncertainties regarding economic growth, increased penetration of alternative energy technology as well as efficiency improvements in energy production and use. The report estimates that oil and gas will still dominate global energy mix for a couple more decades to come, reaching a share of about 52 percent by 2040. Meanwhile, the changing trend in global energy policy is exemplified by the World Bank press release on 12th December 2017. The World Bank Group, one of the largest multilateral lenders to developing countries, announced that after 2019, it would no longer fund upstream investment in oil and gas (World Bank, 2017). The implication is that a key avenue for developing countries to raise funds for the exploitation of their hydrocarbon resources as an important source of financing their development would have been shut.

Several countries have provided indicative targets on when to ban the use of petrol and diesel cars and or the proportion of electric cars to fill up their roads. The United Kingdom and France plan to ban the sale of petrol and diesel cars by 2040 (International Energy Agency, 2017; British Broadcasting Corporation, 2017 – 28th September edition of “Inquiry”³). Norway and the Netherlands plan to achieve the same feat by the year 2025 while China plans to hit a target of 20 percent of electric vehicles by 2025 (Ibid). Furthermore, India and China are both working around a target of selling only electric cars by 2030. Major vehicle manufacturing

³ A British Broadcasting Corporation (BBC) News Weekly Podcast. Confirmed by a Natural Resource Governance Institute (NRGI) publication titled “In Low-Carbon Future, Better Minerals Governance Could Power Development”. <https://resourcegovernance.org/blog/low-carbon-future-better-mineral-governance-could-power-development>. Accessed 26th July, 2018.

companies such as Volkswagen, BMW, Jaguar Land Rover, Honda and Volvo have followed up on this ambition with similar targets.

These global developments give credence to the need for resource-rich countries to diversify their revenue base beyond hydrocarbons. Developing the potential of other non-resource revenues in general and non-resource taxes, in particular, would also be critical, going forward. With regards to the latter, smoothening tax rates over time has a less distortionary impact on the economy compared to knee-jerk reactions in the form of tax hikes in times of resource revenue declines due to say commodity price shocks. An institutional framework that maximizes revenue from natural resources while at least preserving flows from the non-resource sector would be important for sustaining the total resource envelope for financing development in developing countries.

1.4 A New Dataset with New Opportunities for Research

An important challenge to understanding the relationship among natural resources, institutions and non-resource tax effort is with data availability. Getting access to accurate, consistent and wide coverage of data on public finance in general and resource revenues, in particular, was a challenge for researchers (Prichard, 2016; Prichard, Cobham, & Goodall, 2014). Despite efforts by different research institutions and international organizations to collect such data, there were gaps, which compromised the validity of some earlier research findings (Prichard, 2016). The new Government Revenue Database (GRD), developed by the International Conference for Taxation and Development (ICTD) in 2014 and currently hosted by the United Nations University's World Institute for Development Economics Research (UNU WIDER), has breathed a new lease of life into this area of research. Thus, the verdict on whether natural

resources exert a displacement effect, synergy effect or no effect at all on non-resource tax effort is still evolving.

With the emergence of this new dataset and the opportunity it offers for more rigorous analysis, the concerns about variability in data quality, measures and methods are reduced significantly.

1.5 Outline of Dissertation

There are five chapters in all. Three out of the five chapters (chapters 2 through 4) are as empirical chapters. Each empirical chapter attempts to respond to one of the three main research questions. Chapter one constitutes the introduction to the dissertation. It discusses the background and problem statement, presents the overall objective and research questions, as well as a justification for the research. The first empirical chapter is chapter 2. It attempts to unpack the concepts of a natural resource curse and a fiscal resource curse. More importantly, it seeks to theoretically and empirically re-examine the relationship between resource revenues and non-resource tax effort. The second empirical chapter, chapter 3, examines whether the type and quality of institutions mediates the relationship between natural resource rents and non-resource tax effort. It investigates whether the quality of institutions is able to undo the fiscal resource curse. Chapter 4 is the final empirical chapter. Here, we assess the differential impact of different types of natural resources on non-resource tax effort.

Each empirical chapter follows a similar format. There is a literature review, followed by a theoretical framework. Next, we discuss the data and methodology under the empirical framework. This is followed by the presentation and discussion of results. Each empirical chapter is concluded with a chapter summary. Chapter 5 looks at an overall conclusion,

including possible implications of the key findings. The chapter also discusses limitations as well as opportunities for future research. We present the bibliography and appendix at the end of chapter 5.

CHAPTER TWO

2.0 EVALUATING THE RELATIONSHIP BETWEEN RESOURCE REVENUES ON NON-RESOURCE TAX EFFORT

This chapter evaluates the relationship between resource revenues and non-resource tax effort. It examines a variant of the fiscal curse, which suggests that resource revenues displace non-resource tax effort. There are 5 sections spanning a literature review, a theoretical framework, an empirical framework and a presentation of results and discussions. The final section provides a chapter summary.

2.1 Literature Review

2.1.1 Introduction

The body of literature on the natural resource curse is vast. The extant literature reflects different methodologies with increasingly varied dimensions of the measures and mechanisms explored. The literature can be categorized into three points of view. There are those studies that find natural resources as detrimental to growth and a variety of development outcomes (Masi, Savoia, & Sen, 2018; Badeeb, Lean, & Clark, 2017; Mlachila & Ouedraogo, 2017; Sala-i-Martin & Subramanian, 2013; Collier 2010; Collier and Hoeffler 2009; Collier and Goderis, 2007; Collier, 2007; Sach and Warner, 1995). Then there are those sets of studies that test and confirm the theoretical argument for how natural resources should translate into beneficial development outcomes (Mamo, Bhattacharyya, & Moradi, 2019; Allcott & Keniston, 2018; Haber & Menaldo, 2011; Alexeev & Conrad, 2009; Brunnschweiler & Bulte, 2008; Brunnschweiler, 2008; Raddatz, 2007; Stijn, 2000; Deaton and Miller, 1995).

In recent times, there have been an increasing number of studies that point to a rather nuanced relationship between natural resource dependence and development outcomes. The argument is that the impact of natural resources on development outcomes is conditional on a set of contextual and methodological factors. These factors include the period under consideration, that is, the short-run versus long-run argument (Henry, 2019; Arezki, Ramey, & Sheng, 2017; Omgba, 2016; Smith, 2015; Woldeyes, 2013; Alexeev & Conrad, 2009), type and quality of institutions in place (Abdulahi, Shu, & Khan, 2019; Alsharif & Bhattacharyya, 2016; Arezki and Gylfason, 2013; Botlhole, Asafu-Adjaye, & Carmignani, 2012; Fosu, 2011; Boschini, Pettersson, & Roine, 2007; Mehlum, Moene, & Torvik, 2006) and the type of natural resources in question (Yanikkaya & Turan, 2018; Bhattacharyya, Conradie, & Arezki, 2017; Boschini, Pettersson, & Roine, 2013; Knack, 2009). Other factors include the structure of the economy prior to the emergence of the natural resource sector (Allcott & Keniston, 2018; Hausmann & Rigobon, 2002), the methodology used or any combination of the aforementioned factors (Bhattacharyya & Mamo, 2019; Van Der Ploeg & Poelhekke, 2017; Venables, 2016; Collier & Goderis, 2009; Corden & Neary, 1982). Furthermore, while many of the previous studies have engaged with cross-country analysis, there have been an emerging set of studies that look at the resource curse hypothesis from a country-specific perspective (Zhang & Brouwer, 2019; Alexeev & Chernyavskiy, 2015; Borge, Parmer, & Torvik, 2015) or at the micro-level. Van Der Ploeg & Poelhekke (2017) provide a recent survey of the quantitative literature.

2.1.2 The Fiscal Implications of Natural Resource Dependence

Academic interest in the natural resource curse literature has spawned a set of studies that look at the impact of natural resource wealth on fiscal policy. While this body of work is only emerging, areas explored are usually with regards to the implications of natural resource wealth on public expenditure and tax capacity. Here again, the evidence on the effect of natural

resource dependence on public investment is mixed. Some studies cite a positive effect on public goods - infrastructure and social services (Karimu, Adu, Marbuah, Mensah, & Amuakwa-Mensah, 2017; Caselli & Michaels, 2013) while others indicate a negative effect (Edwards, 2016; Cockx & Francken, 2016; Gylfason, 2001). Similar to the trend in the natural resource curse literature, there are also those studies that present evidence of a relationship conditioned on a set of factors (for example, Sarr & Wick, 2010).

The focus of this section and the next, however, is on the revenue side fiscal policy. We begin by examining the key channels through which natural resource wealth or dependence translates into adverse development outcomes and then hypothesize on its possible impacts on domestic revenue mobilization. The key transmission channels through which natural resources undermine development outcomes as discussed in the literature include the ‘Dutch disease’, rent-seeking behaviour, conflicts, and excessive borrowing in anticipation of windfalls from resource exports. Frankel (2012) and Collier & Goderis (2008) provide a survey of related literature on these transmission mechanisms.

Other factors discussed are both intended and unintended consequences reflected in unequal distribution of wealth, breakdown of institutions, volatility in global commodity prices and a decline in terms of trade, following the Prebisch-Singer hypothesis (Lederman & Maloney, 2007). Table 1 discusses these transmission channels and how they impact on domestic revenue mobilization effort. The first column indicates a plausible channel for the manifestation of a natural resource curse. The second column briefly describes the mechanism while the third column examines how the mechanism potentially translates into adverse consequences for domestic revenue mobilization. To cite an example from Table 1, a notable transmission channel for a resource curse is the “Dutch Disease” channel. The term “Dutch Disease”, coined

by the Economist magazine in 1977, derives from the discovery and exploitation of gas resources in the Netherlands during the 1960s. The resource revenues accruing to the hydrocarbon sector brought with it an appreciation of the local currency. The currency appreciation rendered the prices of manufactured goods and other non-tradable goods uncompetitive. This is a disease which translates into a squeezed non-resource sector, narrow tax base and eventually lowers tax performance.

Table 1: Channels and mechanisms for resource curse with possible implications for domestic revenue effort

Channel	Mechanism	Effect on Domestic Revenue Effort
Dutch Disease ⁴	Revenues from resource exports lead to appreciation of local currency thus triggering a ‘diseased’ non-resource sector. Competitiveness reduces in non-resource sector thereby undermining diversification within the economy (Van der Ploeg & Venables, 2013; Klein, 2010; Gylfason, 2001)	Narrows the tax base and thus limits opportunities for revenue mobilization.
Poor Governance and Institutions	Promotes rent-seeking behaviour and redistribution of wealth through goods and services provisioning in lieu of political support (Klomp & de Haan, 2016; Arezki & Gylfason, 2013). Other studies find adverse effect of resource rents on corruption, quality of institutions, rule of law and property rights (Knutsen, Kotsadam, Olsen, & Wig, 2017; Caselli & Tesei, 2016; Williams, 2011; Knack, 2009). Defective tax policy in natural resource sector invariably affects investment and tax outcomes in other sectors.	Weakens institutions in general and by extension, those responsible for domestic revenue mobilization. This constitutes a leakage to domestic revenue effort.

⁴ There is evidence to suggest the “true” use of term was actually Netherland’s unsustainable increases in public spending on social services on account of resource booms (Corden, 1984)

Conflict	Natural resources could provide easy money for rebel activity if captured or become a basis for anarchy/conflict as individuals and groups seek control over them. (Lessmann & Steinkraus, 2019; Berman, Couttenier, Rohner, & Thoenig, 2017; Collier & Hoeffler, 2009; Humphreys, 2005; Fearon & Laitin, 2003)	Reduces business confidence, security of capital and thus incentive for business activity or investment. The result would be a narrow tax base and hence tax revenues.
Excessive Borrowing	Expectations of resource rents induce governments to borrow less cautiously (Bawumia & Halland, 2017). Other macroeconomic effects are discussed in the literature (Arezki et al., 2017; Ratti & Vespignani, 2016).	Risk of tax hikes in the future to tackle debt. High tax rates triggers Laffer-curve effect over time. Essentially, less attention is paid to developing appropriate tax policy. Incentives are tilted towards borrowing, usually regarded as an 'easier' option.
Inequality	Perpetrates inequality (accounting for different measures – income and assets, for example) as those who control resource rents hold on to it with little or no redistribution efforts (Parcero & Papyrakis, 2016; Carmignani, 2013; Fum & Hodler, 2010). Inequality could also stem from evolution of the economy from say peasant agriculture to resource sector, where wages are likely to increase and diverge (Lederman & Maloney, 2007).	Reduces incentives among political elite for equity in tax policy. Those who control the resources would prefer to keep it from being taxed. This undermines the potential for widening the tax base. Creates a tax system with significant distortions.
Volatility	Commodity prices are hardly stable over time. The economy is thus exposed to volatility due to commodity price shocks (Mlachila & Ouedraogo, 2017; Kilian & Hicks, 2013; Cuddington & Jerrett, 2008). Davis and Tilton (2005) indicate that prices of commodities could vary by at least 30 percent within a year or two.	Unpredictable revenue flow.
Excess Consumption	Citizens pressure populist governments into dysfunctional choices which leads to recurrent consumption at the expense of investment in the asset base of the economy (Collier, 2017).	Narrow national income base and hence low revenues

Source: Author's construct, 2019

In spite of the negative theoretical predictions of the effect of natural resource dependence on domestic revenue mobilization, it is possible to consider cases where this relationship can be positive. For instance, a windfall from resource revenues could constitute investible resources for building tax capacity and strengthening the administration of an effective tax system. The incentive for this possibility is the acknowledgement that natural resources are exhaustible. The resource sector could be developed to have forward linkages with other sectors (for example the industrial sector) in the economy. A widening of the tax base can be envisaged under such a scenario, which can invariably rake in more tax revenues. Moreover, returns from natural resource can be used to provide essential public infrastructure that opens up the non-resource sector and expands the tax base there. These examples do suggest that the relationship between resource dependence and domestic tax effort could be direct or indirect, positive or negative or any combination of these. Available empirical evidence on the direct relationship between natural resource dependence and domestic tax effort is discussed in the next section.

2.1.3. Do Natural Resource Revenues displace Non-Resource Revenues? Empirical Evidence

In spite of the copious literature on the natural resource curse, there are fewer studies on the relationship between resource revenues and non-resource tax effort. This scope of the literature focusses on the revenue-side of fiscal policy for resource-rich economies (Masi et al., 2018; Mohtadi, Ross, & Ruediger, 2016; Jensen, 2011; Knack, 2009). These studies seek to examine the relationship between resource wealth/income and taxation. Then there are a smaller subset of studies that focus specifically on the relationship between resource revenues and non-resource revenues⁵ or non-resource taxes. Most of such studies concentrate on hydrocarbon-producing economies. They find the existence of a fiscal resource curse, that is, a negative

⁵ Non-resource revenues would usually include tax and non-tax sources (for example, fees, fines, earning from investments and divestiture receipts) within the non-resource sector

relationship between resource revenues and non-resource revenues (Crivelli & Gupta, 2014; Thomas & Treviño, 2013; Ossowski & Gonzales, 2012; Bornhorst, Gupta, & Thornton, 2009). This phenomenon has sometimes been described as a displacement or eviction effect of resource revenues (Knebelmann, 2017). For instance, during the pre-financial crisis period between 1980 and 2005, natural resource revenues increased significantly across Sub-Saharan Africa by about seven percentage points. Non-resource revenue growth was, however, less than one percent (Gupta & Tareq, 2008).

Using longitudinal data covering a global sample of 30 oil-producing countries for the period 1992 to 2005, Bornhorst et al. (2009) employed Fixed-effects and Generalized Method of Moments estimators to investigate the relationship between hydrocarbon revenues and non-hydrocarbon revenues. They find that a percentage point increase in hydrocarbon revenues displaces non-hydrocarbon revenues by about 0.2 percentage points. The authors could be described as part of the *avant-gardes* in this line of work as previous literature had paid little attention to such cross-country studies. More so, the required revenue data for such cross-country analysis was only now emerging and largely spearheaded by a few institutions – notably the International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD) and the International Centre for Taxation and Development (ICTD). In a panel of twenty African countries and fifteen Latin American countries, Thomas and Treviño (2013) and Ossowski and Gonzales (2012) respectively engage in a similar analysis as Bornhorst et al (2009), albeit on a regional basis. They confirm a negative and statistically significant relationship between resource revenues and non-resource revenues.

In the case of Latin American countries, Ossowski and Gonzales (2012) not only look at non-resource revenue performance in resource exporting countries but also the disaggregated

components such as Value Added Tax (VAT) and non-resource income tax. Ossowski and Gonzales (2012) use a combination of statistical and panel econometric techniques, principally relying on a Driscoll and Kraay estimator due to the presence of serial correlation and cross-sectional dependence in the data. The choice of the estimator also stems from the large time series relative to the number of observational units. Ossowski and Gonzales (2012) use a panel of 15 countries for the period 1994 to 2010. The authors confirm a displacement effect of a magnitude of about 0.2 percentage points in non-resource revenues for a percentage point increase in resource revenues, similar to Bornhorst et al (2009). In general, the performance of VAT, excise duty and non-resource income tax in resource exporting countries were inferior to comparator natural resource-poor countries in the region.

Thomas and Treviño (2013) first examine the determinants of non-resource revenues among 42 Sub-Saharan African countries over the period 2000 to 2011. Following Borhorst et al (2009), they investigate the relationship between resource revenues and non-resource revenues using panel econometric techniques including an Arellano and Bond estimator. They find an offset of about 0.15 of a percentage point for a percentage point increase in resource revenues. This is a long-run estimate. The contemporaneous effect is, however, lower and sensitive to the inclusion of additional regressors. They also find that the offset in non-resource revenues in resource-rich countries is better explained by corruption than the level of the statutory tax rates.

Similarly, Crivelli and Gupta (2014) use a global sample of thirty-five developing and emerging economies over the period 1992 to 2009 to investigate the effect of resource revenues on non-resource revenue effort. With regards to the latter, they explore both direct taxes (personal income taxes and corporate taxes) and indirect taxes (taxes on goods and services/VAT and trade taxes). Using fixed-effects and a two-step Generalized Method of

Moments estimator, they confirm an eviction effect in non-resource taxes of a magnitude of 0.3 percentage points for a percentage point increase in resource tax revenues. Indirect taxes such as VAT were found to be most vulnerable.

Evidence suggests that the relationship between resource and non-resource revenues need not be negative. For instance, Venables (2016) find that resource revenues could serve as a means of transferring funds from the public sector to the private sector. This transfer can either be through investment in public goods or direct support through targeted subsidies and other incentives. Such action could propel the private sector as the “engine of growth” and boost employment in the non-resource sector. It is possible to expect this to impact positively on non-resource revenues over time. Bjornland and Thorsrud (2016) provide evidence of the plausibility of such positive spillovers from the resource sector to the non-resource sector. More recent evidence on this possibility is highlighted by Knebelmann (2017). In a global sample of 22 developing and emerging countries for the period, 1998 to 2012, Knebelmann (2017) does not find consistent evidence to support the eviction effect or a fiscal resource curse for that matter. Using a pooled Ordinary Least Squares (OLS) methodology for variations in non-oil taxes and oil taxes, she finds a “weak synergy effect” in some specifications, albeit sensitive to evolution in the oil economy. The synergy effect suggests that improvements in revenue effort in the oil sector could extend positive externalities to non-oil revenue mobilization efforts.

2.1.4 Contribution to the literature

This study uses the ICTD-UNU-WIDER Government Revenue Database (henceforth ICTD-GRD) to re-examine the relationship between resource revenues and non-resource tax effort. Our main outcome variable of interest is non-resource tax (as a percentage of GDP) rather than

non-resource revenues. Our preference for non-resource tax allows us to shed light on fiscal capacity. Our outcome variable of interest does not include other non-tax sources such as fees, fines, returns on public investments, divestiture receipts, among others. The focus is on taxation outside the natural resource sector and not non-resource revenues. Second, previous studies mostly focused on hydrocarbon-producing (oil and natural gas) countries and therefore hydrocarbon revenues. This choice could partly be attributed to the dominance of oil and gas resources in the global energy mix but also in the global natural resource trade. The few studies that go beyond hydrocarbons are challenged by data limitations (for example, coverage and comparability of variables) thus restricting empirical analysis to fewer countries and or within specific geographical regions. The use of the second version of the ICTD-GRD allows us to explore the fiscal resource curse using a larger set of countries and covering different types of non-renewable natural resources. The latter is lacking in the literature.

We undertake an analysis that allows for the examination of the evidence from a global level to defined local contexts. This allows us to test the sensitivity of the results to sample selection. In addition to exploring conventional panel econometric techniques, we employ a novel instrumental variable strategy that allows us to look at the impact of external factors that mediate between the relationship resource revenues and non-resource tax effort but had been largely ignored in previous literature. Previous studies have tended to focus more on the local factors driving the results (for example level of informality, tax administration, corruption, and other institutional bottlenecks) without much attention to external factors (different types of foreign aid, international trade on natural resources, global co-operation and diplomacy). To the best of our knowledge, none of the studies in this area have accounted for China's increased role in the resource trade since her accession to the World Trade Organization in 2001 and how that impacts on the relationship between resource revenues and non-resource tax effort.

2.2 Theoretical Framework

2.2.1 Introduction

The theoretical framework for this dissertation is largely driven by theories developed to explain the natural resource curse. Like the empirical literature, there are several dimensions to this theoretical literature. Two strands are prominent; namely, the market-based theories and the political economy theories of the natural resource curse (Deacon, 2011). These two strands have been consolidated in other works to provide a comprehensive view on the theoretical relationship between resource dependence and fiscal capacity (Besley & Persson, 2014; Besley & Persson, 2013; Jensen, 2011).

Two other intersecting theoretical frameworks feed into the theoretical exploration of the relationship between natural resources and taxation. These are the theory of optimal taxation as proposed by Frank Plumpton Ramsey (Ramsey, 1927) as well as theoretical discussions on the importance of institutions as proposed by the New Institutional Economics school (Williamson, 2012; North, 1986). The latter is revisited in chapter 3. Meanwhile, one of Ramsey's (1927) key arguments is that commodities with inelastic demand should be taxed at a higher rate than those with an elastic demand.

2.2.2 Market-Based and Political Economy Models of the Resource Curse

The theory of the Dutch disease, also referred to as the booming sector models fits the market-based models of the resource curse. It conveys the idea of a trade-off between a vibrant or well-performing natural resource sector and a diminished or non-performing non-resource sector, often resulting from exchange rate movements which lead to de-industrialization. The reasons given generally reflect negative spillover effects inflicted on the non-resource sector for

tradable and non-tradable goods. For instance, price volatility in the resource sector is transferred to the non- resource sector through pro-cyclical spending decisions by the public sector leading to fluctuations in economic activity (Villafuerte & Lopez-Murphy, 2010). Both government and private investors respond accordingly to economic volatility. For instance, adverse price shocks mean less public investment in the non-resource sector, depriving the sector of critical enablers of state capacity such as infrastructure and energy to drive expansion. Using international trade theory, Corden & Neary (1982), Corden (1984) and Neary & Wijnbergen (1985) discuss static and dynamic models and their predictions for the manifestation of the Dutch disease.

In their base model, Corden & Neary (1982) define a small-open economy producing two tradeable goods whose prices are determined exogenously. Then there is a third good, non-tradeable, whose price is determined by local market forces. The two tradeable goods are energy goods and manufactures respectively, while the third good represents services. A host of assumptions include the fact that the relative price of the traded goods does not change while relative prices of non-traded goods to traded goods is defined as the real exchange rate and subject to change⁶. In accordance with the Heckscher-Ohlin model, their model allows for inter-sectoral mobility of at least one factor of production. The effect of a boom in the energy sector is modelled to yield two results: a spending effect and a resource movement effect. In the case of the latter, a boom in the energy sector increases the marginal productivity of factors employed there. This attracts mobile factors from other (source) sectors leading to equilibrium readjustment in the economy. This readjustment is to the detriment of the source sectors. Indeed, the movement of labour from the manufacturing sector to the booming sector is one direct effect leading to de-industrialization. Also, the movement of labour out of the services

⁶ Output in the manufacturing sector is taken as the numeraire.

sector results in a fall in output, which creates an excess demand for services. Prices must rise to restore equilibrium. The resulting change in relative prices means an appreciation of the real exchange rate.

In a situation where the rate of absorption of resources (as a result of the resource movement effect) from the source sectors into the booming energy sector is low, the impact described above becomes limited. Consequently, a spending effect kicks in. The expected increases in real income from the boom triggers increases in the consumption of services. A direct consequence is an increase in relative prices leading to a real exchange rate appreciation, in addition to other adjustments. The spending effect is however conditional on the marginal propensity to spend on services in the economy. The upshot of these effects is a decline in the manufacturing sector. In further extensions to their model, Corden & Neary (1982) demonstrate, however, that these effects need not necessarily lead to a de-industrialization of the economy. In the context of a long-run, free mobility of capital can be assumed across the manufacturing and services sectors. Then there is still excess labour based on the fact that the amount in use by the energy sector is only a portion of the total. The authors demonstrate that a boom in the energy sector could actually provide a boost to the manufacturing sector. Assuming a muted spending effect due to a zero-income elasticity of demand for services, the authors postulate that a resource boom triggers a resource movement effect. That is, the boom increases the demand for labour, which reduces the amount available to the labour-intensive sector. On the basis of the Rybczynski theorem, output increases in the sector that uses capital intensively while output in the services sector reduces. The theorem, therefore, suggests a boost to the manufacturing sector.

Our theoretical framework also reflects the model developed by Besley & Persson (2010; 2009) and extended by Jensen (2011). These models provide insights into determinants of fiscal capacity. Jensen (2011) demonstrates how fiscal capacity is impacted on account of a positive shock to the non-resource sector. The incumbent social planner is incentivized to mobilize taxes from the non-resource sector as resources become available to develop the required administrative infrastructure. In effect, the cost of investing into developing fiscal capacity today is weighed against the benefit of a potentially higher tax take in the future. The decision reflects a forward-looking behaviour on the part of a rational social planner who cares about the size of the tax take, irrespective of the intended use. A corollary to a revamped non-resource sector is presented in the model as a diminished level of resource dependence. While this view of reduced resource dependence in the face of an improved non-resource sector cannot be interpreted as automatic, the model adds to our understanding of what factors drive fiscal capacity within resource-rich contexts. A key model prediction is that investment in developing fiscal capacity decreases with increasing resource intensity (Jensen, 2011).

2.2.3 The Besley-Persson Model on the Relationship between Resource Revenues and Non-Resource Tax Effort

In further extensions to their earlier models (Besley & Persson 2009, 2010), Besley & Persson, (2013) explore key determinants of fiscal capacity. The Besley-Persson models present useful features for exploring our research questions. The choice to examine Besley & Persson, (2013) is in the fact that they provide insights into understanding the role of both economic and institutional factors in explaining fiscal outcomes in the presence of natural resource sector. Furthermore, they incorporate insights from the literature on the theory of optimal taxation, in particular, A.C Pigou's question on how to maximize taxes on different types of commodities

while keeping the distortions and disutility generated to the barest minimum⁷. Their main focus on internal factors (i.e. interplay of variables within a country) opens up space for further exploration of relevant external factors that affect the ability of open economies to improve fiscal capacity. While the model accounts for the role of aid in some extensions, other external factors remain less explored in explaining fiscal capacity. In particular, we take advantage of the strengths of the model to examine the impact of increased global trade in natural resources. The latter has been characterized by different arrangements including the so-called resource-for-infrastructure deals, which has implications for developing fiscal capacity.

In this section, we describe a generalized model developed by Besley and Persson (2013), emphasizing on the nature and role of resource-for-infrastructure deals in shaping non-resource tax effort in resource-rich countries. Given the attractive but also enclave nature of the natural resource sector in many developing countries, new finds absorb a great deal of government attention. Both human and non-human resources are therefore re-directed towards getting the most out of the natural resource sector. This leaves the rest of the economy, requiring extra effort to develop its fiscal potential. Thus, developing fiscal capacity in the larger non-resource sector sometimes poses a greater challenge. Our focus on the non-resource sector is also in keeping with Besley and Persson (2011), who define fiscal capacity as the ability to raise revenues from a broad base. The explicit distinction we make between a natural resource and the non-resource sector of the economy is a key departure from Besley and Persson (2013), who allow for many different sectors.

⁷ One of Ramsey's key theoretical results in response to this question is to maximize revenues from the commodity with the least price elasticity of demand (Ramsey, 1927b).

We present salient features of the Besley and Persson model (2013), henceforth B-P model. Improvement in the statutory tax take is modelled as a forward-looking investment by a state to increase its fiscal capacity (Besley & Persson, 2010). Better revenue outcomes is achieved through reduction in non-compliance to the fiscal regime in place. For a formal presentation of the model, we first provide key definitions:

The authors consider two time periods denoted by s ; where $s = 1, 2$ for the first and second periods respectively. There exist two main groups in the population $J_s \in \{I_s, O_s\}$. I_s and O_s represent the incumbent group and opposition group respectively. To accommodate a distinction between sectors, we define an economy $k_i \geq 0$ for all $i=1,2$, with k_1 representing a natural resource sector and k_2 representing a non-resource sector. The natural resource sector is mainly characterized by the production of non-renewable resources (hydrocarbons and minerals) while the non-resource sector (k_2) forms the base of the economy outside the natural resource sector⁸. The natural resource sector may form a significant base of the export sector, however by employment size, the non-resource sector is much larger as well as more complex in terms of types and quantities of products.

Moreover, the non-resource sector has a larger tax base than the resource sector. The economy produces $N+1$ consumption goods, where $n \in \{0, 1, \dots, N\}$. Let $x_{n,s}^J$ represent consumption of commodity n by group J at period s . We define explicitly, government provision of public goods g_s which is funded through taxation and borrowing. Variants of the latter would include resource-for-infrastructure deals, where a foreign government provides public goods upfront

⁸ Our definition for natural resource sector in the model remains consistent as used in the rest of the dissertation. The distinction between sectors does not impact substantively on the model, noting that Besley and Persson generalize the sectors to be defined by multiple goods and services.

in period 1, in lieu of payments through non-renewable commodity exports in period 2. In this case, we define public goods provision as $g_s = g_o(1 + \rho)$, where g_o captures government spending on public goods funded through domestic revenues while ρ measures the proportion of government spending on public goods provided for by foreign governments (principally defined by resource-for-infrastructure deals). The explicit discussion on how government funds public goods is an important addition which the B-P model implicitly assume. Labour supply from the population is given by L_s^J at a cost of ω_s^J to the government⁹. Tax rates are defined by $t = \{t_{1,s}, t_{2,s}, \dots, t_{N,s}, t_{L,s}\}$ so that after-tax price levels and wage levels are: $p_{n,s}(1 + t_{n,s})$, $n = 1, 2, \dots, N$ and $\omega_s^J(1 - t_{L,s})$ respectively.

The B-P model defines tax evasion and other forms of non-compliance to statutory tax policy. There is also an informal sector characterized by non-payment of taxes. These features are defined by a parameter $\varepsilon_{n,s}$, total amount of undisclosed consumption or income, which is decreasing in the level of investment in fiscal capacity of the state $\tau = \{\tau_{1,s}, \tau_{2,s}, \dots, \tau_{N,s}, \tau_{L,s}\}$. Proxies used in capturing the concept of fiscal capacity include tax to GDP ratio, income tax to total tax ratio, non-trade tax to total tax ratio and non-resource tax to GDP ratio (Ricciuti, Savoia, & Sen, 2018). Here, we make use of the latter (i.e. non-resource tax as a percentage of GDP) as it remains consistent with Besley and Persson (2013) and thus captures a broader tax base (including income taxes) outside the natural resource sector. This base is usually more difficult to tax as it requires a minimum level of administrative infrastructure (Ricciuti et al., 2018; Besley & Persson, 2011). This definition of fiscal capacity in the model is similar to

⁹ Following Besley and Persson (2013), we leave out firms in order to simplify the model but without sacrificing the main insights.

Jensen (2011) and lends the opportunity to obtain theoretical insights into the relationship with resource revenues, which is our main goal.

The total cost of investing in fiscal capacity is denoted by $C^{k_i} = \{F^{k_i}(\tau_{k_i,2} - \tau_{k_i,1}) + f_s^{k_i}\}$, where $f_s^{k_i}$ captures the cost of existing fiscal capacity ($f_s^{k_i} \geq 0$). What the B-P model defines as existing administrative capacity includes records management, trained staff, and other basic logistics. Note that the decision to invest in fiscal capacity occurs in first period. The cost of non-compliance is given by a function $c(\tau_{n,s}, \varepsilon_{n,s})$. Investment in fiscal capacity will, therefore, drive up non-compliance costs and render tax evasion more difficult.

Total tax payments due to government from consumption of commodities then becomes

$t_{n,s} [p_{n,s} x_{n,s}^J - \varepsilon_{n,s}]$ while total tax payments from labour income is $t_{L,s} [\omega_s^J L_s - \varepsilon_{L,s}]$. Having

defined the basic building blocks, the indirect utility for group J is given by:

$$V^J(t_s, \tau_s, \omega_s^J, \xi_s^J) = v(p_{1,s}(1+t_{1,s}), \dots, p_{N,s}(1+t_{N,s})) + v^J(\omega_s^J(1-t_{L,s})) + \pi(t_s, \tau_s) + \alpha_s^J H(g_s(\rho)) + \xi_s^J \quad (1)$$

Where α_s^J and ξ_s^J are the value to which a group in the population places on public goods and the level of cash transfer to a group respectively. Note that the first two terms in equation (1) represent the gains from consumption and labour supply. The third term could be looked at in terms of the profit from tax evasion or non-compliance or simply tax reductions. Meanwhile, the revenue objective function of government is given by:

$$R(t_s, \tau_s) = \sum_{n=1}^N t_{n,s} (p_{n,s} x_{n,s} - \varepsilon_{n,s}) + \sum_{J=1}^2 \delta^J t_{L,s} (\omega_s^J L_s - \varepsilon_{L,s}) + rr_s \quad (2)$$

That is, government seeks to maximize tax revenue from commodities and labour income as well as revenues from the natural resource sector (rr_s). The term rr_s is assumed to be stochastic

(Besley & Persson, 2011). Note δ^J as a weighing parameter that informs government transfers to a group¹⁰. Total government revenues then go to providing public goods, meeting transfer payments and investing in fiscal capacity. Besley and Persson (2013), define how these revenues are allocated across the expenditure areas as the public policy problem. The government budget constraint is expressed as:

$$R(t_s, \tau_s) \geq g_s(\rho) + \sum_{J=1}^2 \delta^J \xi_s^J + \kappa_s \quad (3)$$

where

$$\kappa_s = \begin{cases} C^k(\tau_2, \tau_1) & \text{if } s=1 \\ 0 & \text{if } s=2 \end{cases} \quad (4)$$

Assuming a weighted government social objective function, where government assigns fixed weights ψ^J to each group (and $\delta^J \psi^J$ can be normalized to 1). Government maximizes

$$\sum_{J=1}^2 \delta^J \psi^J V^J(t_s, \tau_s, g_s, \rho, \omega_s, \varepsilon_s^J) \text{ subject to equation (3) above.}$$

$$\text{Take } M(\tau_s, rr_s - \kappa_s; \{\delta^J\}) = \max_{g_s, t_s, \varepsilon_s^J} \left\{ \sum_{J=1}^2 \delta^J \psi^J V^J(t_s, \tau_s, g_s, \rho, \omega_s, \varepsilon_s^J) \text{ subject to (3)} \right\} \quad (5)$$

as the maximum value of government payoff. To arrive at the optimal level of investment in fiscal capacity, government chooses τ_2 to maximize

$$M(\tau_1, rr_1 - C^k(\tau_2, \tau_1); \{\delta^J\}) + M(\tau_2, rr_2; \{\delta^J\}) \quad (6)$$

Besley & Persson (2013) obtain their first-order conditions, using envelope theorem to eliminate optimal government and private choices. Their resulting equation is given as:

$$\lambda_2 \frac{\partial R(t_2^*, \tau_2)}{\partial \tau_{k,2}} + \frac{\partial \pi(t_2^*, \tau_2)}{\partial \tau_{k,2}} - \lambda_1 \frac{\partial C^k(\tau_1, \tau_2)}{\partial \tau_{k,2}} = 0 \text{ for } k=1, 2 \quad (7)$$

¹⁰ The assumption here is that the incumbent and opposition groups place similar value on public goods which is higher than the value they place on government transfers

where λ_s is defined as the marginal value of public funds.

The first term in equation (7) suggests that the marginal revenue (future benefit) of investment in fiscal capacity (or non-resource tax effort) is driven by two key factors: the marginal value of public funds λ_2 and the revenue function R (see equation 2). The second term shows how investment in fiscal capacity varies positively with the cost of non-compliance. In other words, individual benefit (profit) from non-payment of taxes diminishes when there is investment in fiscal capacity. This is also the marginal cost to individuals when the state invests in fiscal capacity. From the perspective of government, the second term could also be seen as the marginal benefit of investing in fiscal capacity. The final term represents the marginal cost to the state of investing in fiscal capacity adjusted by the marginal value of public funds in period one. Here, the cost of investing in fiscal capacity increases with both the marginal value of public funds in period one and the cost function (as in equation 4).

2.2.4. Model Predictions with Implications for Empirical Analysis

Amongst all the predictions derived from the B-P model, our interest is on their prediction of the effect of resource revenues on the fiscal capacity of a resource-rich country. This is most relevant to our first research question. Based on equation (7), Besley & Person (2013) predict a negative relationship between resource revenues and investment in fiscal capacity. In their view, a discovery of a natural resource, say oil, in period one, reduces the incentive to invest in fiscal capacity in the next period in anticipation of revenue inflows in that period. In other words, the prospect of earning windfalls in the next period relaxes the need to follow through with commitments to investing in fiscal capacity, which carries real costs. They argue that the discovery of a natural resource, which creates opportunity for earning additional revenue in the next period, reduces the marginal value of public funds λ_2 (that is, tax revenues in the next period). This incentive-effect invariably undermines commitment to investing in fiscal

capacity. They cite the empirical work of Jensen (2011) to support their prediction. Jensen (2011) finds that a 1 percent increase in natural resource rents reduces fiscal capacity by 1.4 percent. Notwithstanding this conclusion, it is important to note that Besley and Persson (2013) acknowledge that resource revenues may be beneficial to the effort of building capacity although they do not provide a formal treatment of this possibility. They also acknowledge that countries that are under foreign debt obligations are more likely to place a higher value on tax revenues in the next period (λ_2). We combine these two important insights as follows.

First is to re-state the fact that the provision of public goods that can be funded by both domestic resource and support from development partners. This introduces an important dynamic to the predictions of the model. Consistent with what pertains in most countries, governments depend on a mix of internal revenue and external revenue sources to fund public goods. This suggests that $0 \leq \rho \leq 1$. External support can also be conceived as in-kind support (through equipment purchases, provision of public goods, etc.) in exchange for receipts from export of natural resources. In effect, resource-rich countries could negotiate and leverage on their resource wealth to secure financing for public goods provision. One such form of financing is through resource-for-infrastructure deals. The empirical literature suggests that resource-for-infrastructure deals as a form of borrowing have long existed and are being used increasingly to fund public goods in many countries around the world (Alemayehu, 2018; Lin & Wang, 2016; Halland, Beardsworth, Land, & Schmidt, 2014). The need to pay back external funders in the future for the provision of public goods either through resource revenues or non-resource tax revenues implies that the marginal value of public funds (λ_2) would be high¹¹. This should provides incentives for investing in fiscal capacity. The incentive to invest in non-resource tax

¹¹ Also accounting for the cost of these external funds (for example interest payments)

effort is triggered by the high-value citizens place on public goods. Furthermore, as argued by Besley and Persson (2013), there would be the need to make payments for the cost of infrastructure provided together with the accompanying interest. The volatility of commodity prices suggests that resource-for-infrastructure deals would require an additional buffer. The latter should provide governments with an additional incentive to keep tax revenues flowing in, over time, in order to compensate for commodity price shocks. A possible prediction from the B-P model, therefore, is that the discovery of natural resources or inflow of resource revenues need not undermine investment in fiscal capacity. In fact, there could be expect a positive effect when one takes into account financing arrangements such as resource-for-infrastructure deals. The provision of appropriate infrastructure through such deals (for example, transport, energy and technology) could also reduce the future cost of investing in fiscal capacity and therefore potentially rake in more revenue per unit cost of investment (Pomeranz & Vila-Belda, 2019). Thus, there could be plausible reasons for why the relationship between resource revenues and investment in fiscal capacity could be positive.

A policy to build capacity to optimize revenue mobilization in the resource sector should invariably affects revenue collection in the non-resource sector - barring or limiting the resource movement effect earlier discussed. This is especially the case if the fiscal regime and institutional set up for revenue mobilization in the resource sector is not different from that in the non-resource sector (Knebelmann, 2017). In addition, an increase in resource revenues could suggest increases in direct income which should affect consumption and investment decisions by individuals and firms. The spending decisions could benefit the non-resource sector (Ossowski & Gonzales, 2012; Cordon & Neary, 1982). The concern here though is the relatively capital-intensive nature of the resource sector hence the size of this spending effect is not expected to be large, especially for individuals. The exception though is the lagged wealth

effect discussed by Ossowski & Gonzales (2012). The lagged wealth effect refers to increases in private consumption, investment and general economic activity in the non-resource sector caused by the expectation that resource booms are likely to linger. Another plausible element to sustaining economic activity in the non-resource sector is the expectation that incomes are likely to increase in the future due to favourable commodity prices. These possibilities are to be expected to impact positively on non-resource tax effort and therefore the levels of revenue mobilized from the non-resource sector.

The B-P model studies the behaviour of several other factors with implications for determining fiscal capacity. These include the level of income, evolution of the structure of the economy, institutional factors and aid. For instance, the higher the income for a given statutory tax rate, the higher the revenue outcome and hence the greater the capacity for the state to invest in an effective monitoring and compliance system. Secondly, a structural change which moves an economy towards less dependence on agriculture, more formality and a modernized/urban economy matters for widening the tax base and thus provides a basis for investing in fiscal capacity. Furthermore, the models predict that the “cohesiveness” of political institutions as defined by constraints on the executive or effective representation of opposition parties impacts positively on fiscal capacity as it encourages more spending on public goods relative to transfers coloured by adverse incentives.

2.3 Empirical Framework

2.3.1 Model Specification: Relationship between Resource revenues and Non-resource tax effort

This section proposes an empirical strategy which explores the relationship between resource revenues and non-resource tax effort using a variety of panel econometric techniques. Our approach provides a consistent way of checking the robustness of the results. The choice of the

econometric model specifications is informed by the theory on the determinants of fiscal capacity and the empirical literature on determinants of domestic revenue mobilization. The B-P models show how factors such as income, the structure of the economy, institutional factors and aid impact on fiscal capacity. We are also guided by the empirical work of Bornhorst et al. (2009)¹² and Gupta (2007) on the determination of fiscal capacity, which then informs our econometric specification. The base econometric model specification is given as:

$$\left(\frac{R^{NR}}{Y}\right)_{it} = \beta_0 + \beta_1 \left(\frac{R^R}{Y}\right)_{it} + \omega' controls_{it} + \varphi_i + \tau_t + u_{it} \quad (1)$$

Where u_{it} is the error term;

ω' is a vector of coefficients for the list of control variables (controls);

τ_t represent the time dummies from 1980 to 2015;

φ_i represents the country fixed effect; where

i is the cross-sectional unit (i.e. country) and t is the time dimension.

The main explanatory variable $\left(\frac{R^R}{Y}\right)_{it}$ is resource revenue¹³ as a percentage of Gross Domestic Product (GDP) for country i at time t . The explained variable is $\left(\frac{R^{NR}}{Y}\right)_{it}$ non-resource tax revenues as a percentage of GDP for country i at time t . The vector of control variables include trade as a percentage of GDP, agriculture value-added as a percentage of GDP, a natural log of GDP per capita and control of corruption. The country-specific effects (φ_i) allow for unique intercepts for each country and thus captures unobserved country differences that might be

¹² Our work however fundamentally differs from Bornhorst et al. (2009) in a number of ways. First, we used an improved data source with better coverage and more consistent measures. Second we go beyond hydrocarbons to look at minerals. Third, we employ a robust and novel empirically strategy that addresses key concerns such as measurement error and endogeneity.

¹³ Used interchangeably with natural resource revenues. Includes revenue from hydrocarbons and minerals.

correlated with our main explanatory variable as well as the dependent variable. The period dummies (τ_t) capture globalization issues and other macro shocks or policies that are likely to be correlated with both resource revenues and non-resource taxes. The error term (u_{it}) is assumed to exhibit white-noise characteristics. It is independently and identically distributed with zero mean and constant variance. Other control variables are introduced as part of robustness checks. These include the quality of political institutions, constraint of the executive, inflation and population. Our global sample comprise both developed and developing countries which produce hydrocarbons and minerals.

The starting point for our choice of econometric specification was a revisit of the literature (theoretical and empirical) on the determinants of tax revenues, tax effort or tax capacity. As expected, there are similarities but also significant differences in the choices of explanatory variables used in studies on the determinants of tax revenues. There are however points of congruence with reasonable theoretical justification thus making it possible for us to settle on our model specification (Besley & Persson, 2013; Gupta, 2007). For instance, the size of an economy measured by GDP per capita should matter for the tax revenue capacity and ultimately the tax revenue outcome for any country (Besley & Persson, 2013; Lotz, Morss, & Finance, 1965). Per our apriori considerations, GDP per capita is expected to have a positive effect on non-resource tax revenues. All things being equal, the higher the income, the larger the base for taxation. Similarly, there exist significant evidence on the relationship between the volume and type of aid flows to a country and its tax performance (Mascagni, 2016; Morrissey, 2015; Benedek, Crivelli, Gupta, & Muthoora, 2014). The relationship is generally ambiguous. There are studies that suggest a positive relationship between aid and tax performance, especially when aid is directed towards building the capacity of state revenue institutions (for example Clist, 2016; Mascagni, 2016). Others point to a negative relationship, where aid substitutes tax

revenue mobilization (Benedek, Crivelli, Gupta, & Muthoora, 2014). Incumbent government are happy to free themselves from the costly (including accountability) requirements of tax revenue mobilization. This has been the case in poor countries where aid sometimes exceeds tax revenue (Besley & Persson, 2014).

Drummond, Srivastava, Daal, and Oliveira, (2012); Mahdavi, (2008) and Gupta, (2007) demonstrate the influence of trade openness as well as the structure of an economy on tax outcomes. The larger the volume of trade for a country, the greater the potential for a higher revenue take in the form of trade taxes. The roll-out of trade liberalization policies within the context of the World Trade Organization (WTO) rules as well as the Washington Consensus has however meant that many developing countries have suffered from a decline in amounts realized from trade taxes. Furthermore, the structure of the economy (also referred to as the evolution of the economy) is taken into account by controlling for agriculture-value added as a percentage of GDP or service value added as a percentage of GDP. The level of corruption is also given considerable attention in the literature and particularly so for developing countries (Bird, Martinez-Vazquez, & Torgler, 2008; Ghura, 1998). Generally, corruption undermines tax revenue effort. We expect non-resource tax revenues to be lower for countries with higher levels of corruption as it signals weak state capacity and poor social norms. On the other hand, Olson, (1993) makes a distinction between a “stationary bandit” and a “roving bandit”. The author suggests that in the former case, a corrupt state could take measures to increase the pie in the non-resource sector in order to maximize its share of the taxes. In that case, non-resource taxes could be increasing in the levels of corruption for a country.

2.3.2 Econometric Methods

We employ panel data techniques in a systematic fashion, guided by economic and econometric theory as well as the empirical literature. We begin with an assessment of the data using scatter plots and lines of best fit. We complement the correlation analysis with a naïve Pooled Ordinary Least Squares (POLS) estimate to explore the relationship between resource revenues and non-resources taxes. Next, we introduce our vector of control variables. The concern with the POLS estimate is that not controlling for unobserved time-invariant differences in country characteristics known as “fixed-effects” may bias our parameter estimate and render our interpretations inaccurate. To address this, we use a Least Squares Dummy Variable (LSDV) estimator, which controls for the fixed-effects. The challenge, however, is that the LSDV estimator introduces $(N - I)$ country dummies in addition to K regressors. The result is a loss of degrees of freedom and a heightening of the incidence of multicollinearity.

To circumvent these challenges while still accounting for heterogeneity of the entity effects, we employ a Random-effects Estimator (REE). The REE is a weighted average of two estimators – within and between. The within estimator captures variation within the entities while the between estimator captures variation across the cross-sectional units. To test for the importance of heterogeneity, that is by extension a choice between POLS and REE, we use a Lagrange Multiplier Test (Breuch-Pagan test). We also test for the importance of time effects both in the pooled POLS and the REE. The REE isolates the unobserved non-random (systematically different) error term (ϕ_i) in accounting for country heterogeneity exogenous to model. In other words, the error term is assumed not to be correlated with the other regressors. We later test the robustness of this strong assumption.

Next, we introduce a Fixed-effects Estimator (FEE), which allows us to relax the exogeneity restriction of the non-random error term. This is more reasonable for the following reason. For instance, with a random-effects model, the geography or location of a country (an individual fixed effect) can be correlated with its level of income or trade, which can then influence fiscal outcomes. If this theoretical reasoning holds true, an FEE would be more appropriate relative to an REE. The data transformation under the FEE allows the correlated effects to be muted. Given that the transformation potentially introduces serial correlation, we account for this in the model. Another drawback of the FEE transformation is the automatic elimination of time-invariant variables. This is not an immediate concern until we attempt to use a dummy variable approach to assess the differentiated impact of hydrocarbon revenues versus mineral revenues on non-resource tax effort. We revisit this scenario in chapter seven.

A Hausman test allows us to evaluate the appropriateness of our choice between the FEE and the REE. The test compares the coefficients of the REE and FEE to see if they converge to the true parameter on the basis that the error terms ($\phi_i S$) are not correlated with the regressors (Adkins & Hill, 2011). The test statistic is a Chi-square distribution with K (number of regressors) degrees of freedom. It is tested against a null hypothesis that all the regressors and error term are uncorrelated. A rejection of the null hypothesis informs the choice of a FEE. Subsequent to examining the contemporaneous or short-term effects, we explore the medium to long-term effects of resource revenues on non-resource tax effort. First, we transform the data into a five-year non-overlapping series. We re-apply the fixed-effects estimators described earlier within a medium to long-term framework (see Fosu, 2013 for a similar treatment). We include this treatment to account for the fact that our key variables of interest may take time to evolve. For some, their impact may only be realizable after a year.

In a number of alternative specifications, we use a Generalized Method of Moments (GMM) Estimator developed by Holtz-Eakin, Newey, & Rosen, (1988), Arellano & Bond (1991), Arellano & Bover (1995) Blundell & Bond (1997) and Blundell & Bond (1998). The case for a dynamic specification is premised on a plausible argument that a shock to a country's non-resource tax revenues may take time to adjust and thus the variable can be persistent over time (Thomas & Treviño, 2013; Bornhorst et al., 2009). To resolve this, the requirement to introduce a lagged dependent variable further introduces the problem of serial autocorrelation. Another effect of using a lag of the dependent variable is the so-called Nickel bias, where, the lagged variable becomes correlated with the country fixed effect. These concerns are addressed within the GMM framework (Roodman, 2008). The GMM estimator also accounts for endogeneity by making use of both internal and external instruments, if the latter is available. Furthermore, the GMM is a more efficient estimator compared to other Method of Moment Estimators such as two-stage least squares or a fixed-effects estimator in the presence of heteroscedasticity (Wooldridge, 2001). Of the two main forms of GMM estimators, we reveal our preference for the "System" GMM over the "Difference" GMM. The former is superior in addressing our concerns of endogeneity by providing a better set up of instruments and producing more efficient parameter estimates (Roodman, 2008; Roodman, 2006). We apply what is referred to as the Windmeijer correction to account for downward bias of the standard errors (Roodman, 2008). While its main drawbacks are in its complexity as an approach (hence subject to abuse) and the problem of instrument proliferation, Roodman, (2008) and Roodman, (2006) provide very useful guidance on how to address these challenges while avoiding potential pitfalls.

Our data and empirical strategy also allows us to explore the extent to which context matters. Besides evaluating the global evidence, we are able to disaggregate results for the developing

world but also for the set of Low-income (LICs) and Lower-Middle-Income countries (LMICs) in our sample. We define the latter as the local context. Again, we explore the effect of other functional forms in variations of the base model. There is the question of whether the effect of resource revenues on non-resource taxes is non-linear. We test for the inclusion of a squared term of our main explanatory variable.

2.3.2.1 Further Robustness Checks

To check the sensitivity of our results to additional and alternative covariates, we introduce variables such as measures of institutional quality, population and inflation. We explore other non-linear relationships that involve the use of interaction terms. Next, we attempt to address the concern that normalizing non-resource taxes with GDP is problematic. The argument is that changes to GDP arising from say increases in natural resource production diminishes our dependent variable automatically and thus biases our parameter estimates (Thomas and Trevino, 2013; Bornhorst et al 2009)¹⁴. An approach suggested in the literature is to normalize non-resource taxes and resource revenues with non-resource GDP and resource GDP respectively. There are severe limitations to the suggested approach. First, non-resource GDP or resource GDP for that matter is generally difficult to measure precisely, over time and across countries. Building comparable data across countries is only now emerging. Additionally, normalizing non-resource taxes and resource revenues with non-resource GDP and resource GDP respectively is not consistent with the standard definition of a tax base (Thomas and Trevino, 2013). Furthermore, this normalization approach or otherwise hardly contradicts the main findings of available studies that consider this issue (Thomas and Trevino, 2013; Bornhorst et al 2009).

¹⁴ It is noteworthy that we normalize both the dependent variable and the explanatory variable by GDP. As a result, if the numerators increase by the same proportion as the denominators, the resulting ratio is unchanged. Moreso, the base model controls for GDP per capita.

2.3.3 Identification Strategy

For our base model specification in equation one of section 2.3.1, the issue of endogeneity is likely and therefore estimates that do not address this problem are not likely to be accurate. While we present arguments on how resource revenues might affect non-resource tax effort, there is reason to expect that difficulties with generating non-resource tax revenues can push governments to focus on mobilizing revenues from the natural resource sector. This presents the case of a simultaneity bias, also referred to as reverse causality. We statistically test for the exogeneity of the main explanatory variable using the Hausman test. The null hypothesis that resource revenues as a percentage of GDP is exogenous is rejected at a probability value close to zero ($P=0.0014$). The result thus confirms our concern about endogeneity. To address this concern, we use a Two-Stage Least Squares (TSLS) approach to obtain exogenous variation in resource revenues as a percentage of GDP. This is achieved through the use of an exogenous instrument. This approach has additional merits, including tackling probable error in variable measurement. This concern is revisited below.

In order to capture the effect of exogenous variations in natural resources revenues on variations in non-resource tax revenue, we construct an instrumental variable. We employ the effect of China's accession to the World Trade Organization (WTO) in 2001 on international trade in natural resources. This was also a period characterized by rising commodity prices and a "new" version of commodity trade referred to as "resource for infrastructure" deals (Venables, 2016). China's policy decision to join WTO increased its role in the global economy, bringing with it a largely positive outcome for the Chinese economy and a rather mixed outcome for other countries (Asquith & Rodriguez-lopez, 2019; Autor, Dorn, & Hanson, 2016; Bloom, Draca, & Van Reenen, 2016; Hu & Jefferson, 2009). China's trade strategy and

its subsequent impact on global trade was different in the period before 2001 compared to the period after 2001. China's demand for metals has skyrocketed from a pre-WTO status value of 3 percent of global demand to 40 percent by end of 2014 (International Monetary Fund, 2016). Similarly, China's demand for crude oil has surged from 1 percent to 11 percent over the same period (ibid.). It is also noteworthy that a third of China's energy imports and a fourth of her crude oil needs comes from Africa¹⁵ (Alemayehu, 2018).

The reverberations around the world associated with China's entry into the WTO has been referred to as the "China shock" (Autor, Dorn, & Hanson, 2016; Bloom et al., 2016). For commodity-producing countries, this shock has led to an increase in the demand for their natural resource exports to feed China's hungry manufacturing industries. China is currently the largest net importer of oil, having accounted for about 50 percent of global growth in crude oil consumption in the decade leading to 2015 (Vasquez, 2018). Thus, China's demand for natural resources holds consequences for resource revenues as it affects global commodity prices (Kilian & Hicks, 2013)¹⁶. Evidence from the October 2016 edition of the IMF's World Economic Outlook further suggest that the responsiveness of global commodity prices (crude oil and metals) to increases in China's demand was only statistically significant post-WTO period and not before.

A source of variation in the instruments and their effect stems for the fact that China's demand for commodities has not been homogenous across countries and over time. Secondly, although many countries have both oil and base metals, most specialize in the production and export of one, depending on the size of available reserves, technology, quality of products and pricing.

¹⁵ The seven countries that provide most of China's import (natural resource) needs in Africa are South Africa, Nigeria, Algeria, Sudan, Congo, Democratic Republic of Congo and Angola.

¹⁶ Other countries like Japan, India and Brazil contributed to this increased demand however relatively less so.

Furthermore, the distance between China and these trading countries is expected to impact on the volume and value of trade and thus resource revenues. We explore variants of the “China shock” as instrumental variables, for example, China’s total imports to GDP ratio and China’s merchandise trade as a share of GDP. However, we focus on China’s natural resource imports (fuel, ore and metals) as a percentage of GDP as our main instrument. The reason is that the latter best satisfies our exclusion restriction. China’s natural resource imports is correlated with resource revenues but not with non-resource tax effort around the globe. The higher the demand for imports by China, the higher resource revenues for a resource exporting country, *ceteris paribus*. We test for the relevance and strength of our main instrument.

The use of an instrumental variable approach further helps to address our concern with the errors-in-variables bias. Despite improvements in the quality of the Government Revenue Dataset (Prichard, Cobham, & Goodall, 2014), we leverage on the IV approach to reduce the impact of measurement errors in biasing our parameter estimates.

2.3.4 Data and Descriptive Statistics

Our choice of panel data in exploring the research questions stem from the many advantages they possess relative to other data types such as time series or cross-sectional data. First, panel data allows us to account for unobserved country heterogeneity which are time-invariant or change very slowly over time. These would include factors such as geography, some aspects of culture and whether a country is land-locked or not. We are also able to control for time-varying unobserved variables like the effect of global shocks. The nature of panel data creates room for improving efficiency of our parameter estimates as it tackles the incidence of multicollinearity and allows for degrees of freedom. In situations where there is persistence in the variables of interest, panel data permits a dynamic specification. Moreover, we derive more

information with dynamic specification when we are interested in, for instance, the speed of adjustment of a variable of interest to policy changes (Baltagi, 2005).

The choice of data and sample can potentially drive results obtained in empirical research. In this regard, we review closely the data and sample of countries used in four studies that we deem most closely related to our first research question. Apart from the differences in the sample of countries used (mostly due to availability of data) for these studies, we also observe that most of them focus on hydrocarbons (mainly oil and gas resources) and as such hydrocarbon revenues. Table 2 accounts for the list of countries used in previous studies. The letter ‘X’ indicates that a country is included while ‘0’ shows that a particular country is excluded in a study.

Table 2: Examining sample of countries used in four related studies

	Country	Bornhorst et al. 2009	Ossowski and Gonzales, 2012	Thomas and Trevino, 2013	Crivelli and Gupta, 2014	Knebelmann, 2017
1	Algeria	X	0	0	X	X
2	Angola	X	0	X	X	X
3	Azerbaijan	X	0	0	0	X
4	Bahrain	X	0	0	X	0
5	Brunei	X	0	0	X	X
6	Cameroon	X	0	X	X	X
7	Chad	X	0	X	0	*
8	Congo (Kinshasa)	0	0	X	0	X
9	Ecuador	X	X _{HR}	0	0	X
10	Equatorial Guinea	X	0	X	X	*
11	Gabon	X	0	X	X	X
12	Indonesia	X	0	0	X	*
13	Iran	X	0	0	X	X
14	Kazakhstan	X	0	0	X	X
15	Kuwait	X	0	0	0	*
16	Libya	X	0	0	0	X
17	Mexico	X	X _{HR}	0	X	X
18	Nigeria	X	0	X	X	*
19	Norway	X	0	0	X	0
20	Oman	X	0	0	X	0

21	Quatar	X	0	0	0	0
22	Russia	X	0	0	X	0
23	Saudi Arabia	X	0	0	X	X
24	Sudan	X	0	0	0	X
25	Syria	X	0	0	X	X
26	Trinidad and Tobago	X	X _{HR}	0	X	X
27	United Arab Emirates	X	0	0	X	X
28	Venezuela	X	X _{HR}	0	0	0
29	Vietnam	X	0	0	X	*
30	Yemen	X	0	0	X	X
31	Iraq	0	0	0	0	*
32	Timor-Leste	0	0	0	0	X
33	Cote D'Ivoire	0	0	0	X	X
34	Belize	0	0	0	0	X
35	Bolivia	0	X _{HR}	0	0	X
36	Egypt	0	0	0	0	*
37	Malaysia	0	0	0	0	*
38	Chile	0	X	0	0	0
39	Colombia	0	X _{HR}	0	X	0
40	Peru	0	X	0	X	0
41	Argentina	0	X _{NH}	0	X	0
42	Brazil	0	X _{NH}	0	0	0
43	Costa Rica	0	X _{NH}	0	0	0
44	El Salvador	0	X _{NH}	0	0	0
45	Honduras	0	X _{NH}	0	0	0
46	Paraguay	0	X _{NH}	0	0	0
47	Uruguay	0	X _{NH}	0	0	0
48	Guinea	0	0	X	X	0
49	Congo (Brazzaville)	X	0	X	X	0
50	Botswana	0	0	X	X	0
51	Zambia	0	0	X	0	0
52	Sierra Leone	0	0	X	X	0
53	Mali	0	0	X	X	0
54	Namibia	0	0	X	0	0
56	Niger	0	0	X	0	0
57	Zimbabwe	0	0	X	0	0
58	Tanzania	0	0	X	0	0
59	Ghana	0	0	X	X	0
60	Central African Rep.	0	0	X	0	0
61	South Africa	0	0	X	0	0
62	Burkina Faso	0	0	0	0	0
63	Lesotho	0	0	0	0	0
64	Uganda	0	0	0	0	0
65	Senegal	0	0	0	X	0

66	Ethiopia	0	0	0	0	0
67	Mozambique	0	0	0	0	0
68	Kenya	0	0	0	0	0
69	Madagascar	0	0	0	0	0
70	Malawi	0	0	0	0	0
71	Rwanda	0	0	0	0	0
72	Liberia	0	0	0	0	0
73	Cape Verde	0	0	0	0	0
74	Mauritius	0	0	0	0	0
75	Seychelles	0	0	0	0	0
76	Swaziland	0	0	0	0	0
77	Benin	0	0	0	0	0
78	Burundi	0	0	0	0	0
79	Comoros	0	0	0	0	0
80	Eritrea	0	0	0	0	0
81	Gambia	0	0	0	X	0
82	Guinea Bissau	0	0	0	X	0
83	Sao Tome and Principe	0	0	0	0	0
84	Togo	0	0	0	0	0
85	Guyana	0	0	0	X	0
	Country total	30	15	20	35	22

“*” means not included due to lack of disaggregated data (direct and indirect non-oil taxes or sectorial value-added). “0” shows countries omitted with or without any explanation. “*NH*” stands for countries labelled as having little or no hydrocarbon revenues while “*HR*” describes those that are mainly or exclusively hydrocarbon exporters.

Source: Author’s construct, 2017

Two of the studies, Ossowski and Gonzales, (2012) and Thomas and Trevino, (2013) are regional studies covering Latin America (15 countries) and Sub-Saharan Africa (SSA) (20 countries) respectively. The three other studies in Table 2 attempt to provide a global perspective on non-resource tax effort in hydrocarbon-producing economies. We emphasize this global perspective by employing data on resource revenues covering a larger set of countries for which there is available data. Our sample extends well beyond the total sample covered in the studies cited and to a larger extent, those used in the literature. Our data is from the 2017 version of the Government Revenue Database (GRD).

2.3.4.1 The ICTD GRD Dataset

The GRD is a standardized dataset on government revenues. The data is disaggregated. For instance, it separates natural resource revenues from other non-resource revenues and has sub-categories of these. There are variables such as total resource taxes, non-resource taxes, indirect taxes, direct taxes, property taxes and trade taxes. The database provides caveats and guiding notes for the use of these variables in empirical research. For instance, we choose the merged version of the database, which combines general government revenue data and central government revenue data. General government revenue data includes revenue aggregated from all of government and thus includes those accruing to the central government and decentralized local authorities. This data is obtainable for a limited set of countries. On the other hand, central government revenues take account of revenues accruing to the central government. Use of central government revenue data would, therefore, underreport total revenue for a country, which has significant revenues accruing from its local authorities or decentralized states, for example. The merged data, which is more comprehensive, captures general government revenue for each country where it is available but captures central government revenue data for a country if there is evidence of limited subnational revenue. A drawback though from the use of the merged dataset is that it underestimates revenues for countries which do not have consistent series of general government revenue (see ICTD GRD User Guide and FAQs, 2017).

Prior to the emergence of the ICTD GRD database in 2014, existing data sources on government revenues suffered a myriad of limitations. These limitations were largely related to data coverage (both across countries and over time); quality and consistency; and reporting and comparability (Prichard et al., 2014; Baunsgaard & Keen, 2010; Keen & Mansour, 2009). There were also challenges regarding the level of government over which the data is aggregated (for example, general government revenue versus central government revenue) and the GDP

series used in normalizing revenue data (Prichard et al., 2014). Challenges with previous data also meant a preference for regional level studies for which data was relatively more comprehensive and consistent. These challenges with previous government revenues databases and their implications for research outcomes have been documented (Clist, 2016; Prichard, 2016; Prichard et al., 2014).

The new ICTD GRD database is a significant improvement over previous attempts to compile comprehensive global datasets on government revenues. It combines the previously existing datasets in a standardized classification system. The rubrics of the system has been transparently documented (McNabb, 2017; Prichard et al., 2014) and available on the UNU-WIDER website. The main sources of the GRD are:

- International Monetary Fund (IMF) Government Financial Statistics (GFS)
- Organization for Economic Co-operation and Development (OECD) Revenue Statistics
- OECD Latin American Tax Statistics
- IMF Article IV Staff Reports
- *Estadísticas de América Latina y el Caribe* (CEPALSTAT) Revenue Statistics in Latin America

The main variables of interest from the ICTD-GRD database are discussed below. This is followed by a review of other source of data relevant to exploring our research questions.

2.3.4.2 Total (Natural) Resource Revenue

The total natural resource revenue variable provides resource revenue data from hydrocarbons (oil and gas) and mining activities. The data includes tax and non-tax revenues from the non-renewable natural resource sector. It is expressed as a percentage of GDP.

2.3.4.3 Non-resource tax

Non-resource tax captures taxes mobilized outside the natural resource sector. It is computed by deducting natural resources taxes from total tax revenues and excluding social security contributions. The amount is expressed as a percentage of GDP.

2.3.4.4 List of Control Variables

Our list of control variables come from the World Development Indicators (WDI) database (World Bank, 2017) and the International Country Risk Guide (ICRG) ((Political Risk Services, 2015). For the subsequent chapters in this dissertation, we refer and define additional variables from data sources including Data on Political Institutions (Cruz, Keefer, & Scartascini, 2016) and the Polity IV dataset (Marshall, Gurr, & Jaggers, 2016). We provide the list of variables used in our estimations in tables of summary statistics. Table 3 provides the list of variables considered for this empirical chapter.

2.3.4.5 Descriptive Statistics

Table 3 presents the summary statistics for key variables used in the estimations of the relationship between resource revenues and non-resource tax effort. The sample is based on the pooled ordinary least squares estimation (POLS) of our base model in equation (1).

Table 3: Summary Statistics for variables in annual series, 1980 - 2015

Variable	(1) Obs.	(2) Mean	(3) St Dev.	(4) Min	(5) Max
Total Non-resource tax as % of GDP	1069	16.016	7.823	0.607	37.577
Total resource revenue as % of GDP	1069	5.592	9.789	0.000	65.569
Grants as % of GDP	1069	0.808	1.777	0.000	24.713
Corruption Control Index	1069	2.937	1.281	0.000	6.000

Agriculture value-added as % of GDP	1069	12.375	11.637	0.050	61.969
Log GDP per capita in constant US\$	1069	8.570	1.489	5.721	11.618
Trade as % of GDP	1069	93.921	62.798	12.009	455.415
Consumer Price Index	973	77.447	36.960	0.000	348.992
GDP Deflator	1069	133.603	259.791	0.000	5068.098
Exchange Rate per US\$	996	758.595	2331.346	0.000	21697.568
Service Value Added as % of GDP	1069	53.220	14.778	12.872	93.115
Chinese Resource Imports as % of GDP	1069	20.392	5.061	9.506	28.444
<i>N</i>	1069				

Column 1 of Table 3 depicts the number of country-year observations between the period 1980 and 2015. Columns 2 through 5 show the period average, standard deviation, minimum value and maximum value respectively. These are corrected to three decimal places. Total resource revenue as a percentage of GDP ranges from zero to approximately 66 percent with a country-year average of 6 percent and a standard deviation of about 10 percentage points. Non-resource tax as a percentage of GDP ranges from between 0.6 percent to about 38 percent with a mean and standard deviation of 16 percent and 8 percentage points respectively. The main instrument, China resource imports as a percentage of GDP, ranges from 9.5 percent to 28.4 percent, with a period average of about 20 percent and standard deviation of about 5 percentage points.

2.4 Empirical Results and Discussions

The section begins with a correlation analysis of the two key variables of interest (resource revenues as a percentage of GDP and non-resource tax as a percentage of GDP) using both a pictorial representation as well as correlation coefficients. Next, we show results of Pooled OLS and Fixed Effect Estimators for the panel data. The section then examines medium-term effects by transforming the data into non-overlapping five-year averages, still using fixed-effects estimators. Having obtained wider *N* (panels) and shorter time periods as a result of the data transformation, we employ an Arellano and Bond estimator (GMM), assessing the plausibility of a dynamic effect and its implication for the relationship between our variables

of interest. Finally, we employ a two-stage least squares estimator in assessing the effect of a China shock on the relationship between resource revenues and non-resource tax effort.

2.4.1 Scatterplot of Relationship between Resource Revenues and Non-Resource Tax

Using a scatterplot, we examine the relationship between the two key variables – total resource revenues as a percentage of GDP and total non-resource tax as a percentage of GDP. The scatterplot in Figure 1.0 shows mean values of non-resource taxes as a percentage of GDP on the y-axis plotted against resource revenues as a percentage of GDP on the x-axis. The data covers the period from 1980 to 2015. A fitted line is included in the scatterplot. A total of 116 countries are captured using the World Bank's Country Classification Code. The choice of country codes over country names is to reduce crowding of the chart area in order to make the scatterplot more legible. The list of countries and their respective codes are attached to the appendix.

Figure 1: Scatterplot of correlation between resource revenues and non-resource taxes: global sample

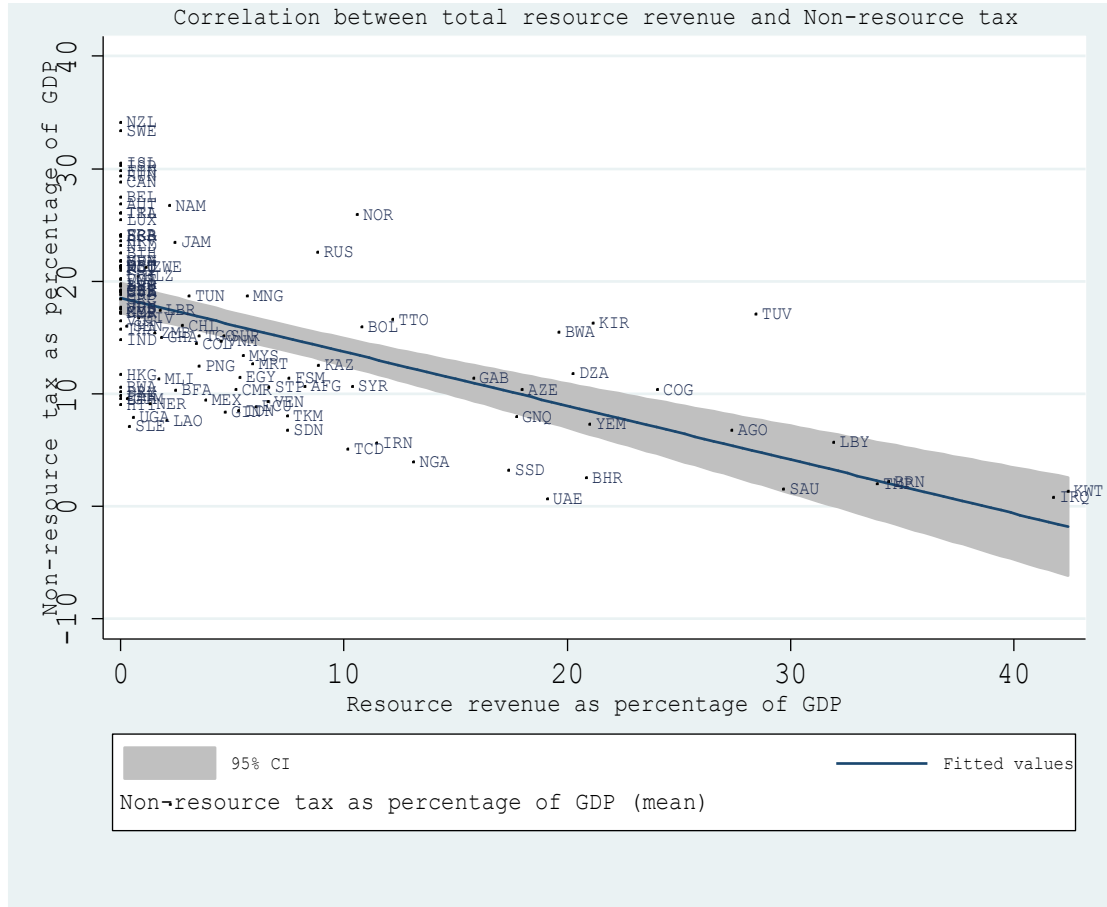
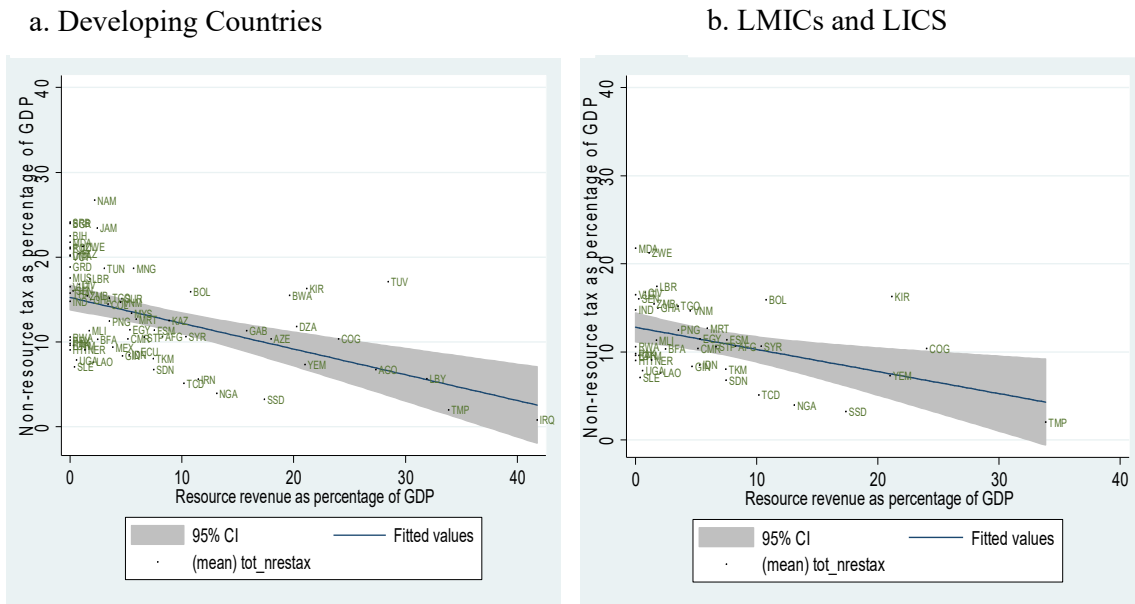


Figure 1.0 shows a negative relationship between resource revenues and non-resource taxes. The fitted line suggests that on average, a country's non-resource tax as a percentage of GDP is decreasing in resource revenues as a percentage of GDP. Thus, ceteris paribus, the higher a country's resource revenue as a percentage of GDP, the lower its non-resource revenue percentage of GDP. In the lower right-hand corner of the chart, countries such as Iraq (IRQ), Kuwait (KWT), Saudi Arabia (SAU), Brunei (BRN) and Timor Leste have high resource revenues as a percentage of GDP (in excess of 30 percent) and low non-resource tax revenue shares (mostly less than 5 percent). On the other extreme are countries such as New Zealand,

Sweden, Finland, Israel and Canada with high non-resource revenues as a percentage of GDP compared to paltry levels of resource revenues as a percentage of GDP (close to zero).¹⁷

Figure 2: Relationship between resource revenues and non-resource tax effort: a. Developing Countries b. LICS and LMICS



In Figure 2a above, we replicate scatter plots for countries in the data that fit the World Bank income classification for developing countries. In keeping with the World Bank's income classification system, we define developing countries to comprise Upper Middle-income Countries, Lower-middle-income Countries and Low-income Countries. On the basis of year 2017 classifications, Upper-Middle-Income Countries are defined as having a Gross National Income (GNI) per capita of between \$4, 036 and \$12, 475¹⁸. Lower-Middle-Income countries have a GNI per capita of between \$1,026 and \$4,035 while Low-income countries have less than \$1,025 in GNI per capita. Figure 2b represents the sample for Low-income and Lower-Middle-Income countries, according to the same method of classification. These plots

¹⁷ The relationship remains negative (downward-sloping) when we drop all countries with zero levels of both resource revenues as a percentage of GDP and non-resource taxes as a percentage of GDP.

¹⁸ The threshold for the 2019-2020 World Bank income classifications are not significantly different: Upper Middle Income countries (\$3996-\$12375), Lower-middle Income (\$1026-\$3995) and Low Income (\$1025)

essentially show that the negative relationship holds even when outliers are dropped. The relationship is however not statistically robust due to econometric problems such as omitted variables and endogeneity. We explore alternative econometric estimators.

2.4.2 Pooled Ordinary Least Squares (POLS) and Fixed Effect Estimates

Table 4 reports POLS estimates for the effect of resource revenues on non-resource tax effort. The first column provides the coefficient of a bivariate regression. The second column includes grants as an additional control variable in view of the concern that it could potentially undermine non-resource tax effort. The third to fifth columns include an additional set of control variables, following Bornhorst et al. (2009). Column 3 omits fixed-effects whereas column 5 includes country and time fixed-effects. Column 4 includes time effect but omits country effects. All specifications have robust standard errors. In column 1, a negative coefficient on resource revenues is obtained. The offset in non-resource taxes as a result of a percentage point increase in resource revenues is about 0.4 of a percentage point.

Table 4: Results based on Pooled OLS and Random-effects Model

Dependent variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) REE
Tot_resrev	-0.408*** (0.0123)	-0.352*** (0.0120)	-0.385*** (0.0169)	-0.373*** (0.0152)	-0.198*** (0.0412)
Grants		-0.0295 (0.0209)	0.104 (0.0859)	-0.0979 (0.0791)	-0.00154 (0.0926)
Corrupt control			1.762*** (0.182)	2.637*** (0.206)	0.615 (0.388)
Agric value-added			-0.118*** (0.0204)	-0.120*** (0.0203)	-0.0137 (0.0691)
Log GDP per capita			1.116*** (0.213)	0.408* (0.234)	1.698** (0.737)
Trade openness			-0.00311 (0.00346)	-0.00633* (0.00356)	0.00314 (0.0106)
Country Effect	No	No	No	No	Yes
Time Effect	No	No	No	Yes	Yes
Observations	2,535	1,830	1,069	1,069	1,069
R-squared	0.284	0.253	0.556	0.597	

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

The negative offset in non-resource taxes is consistent across all five specifications although reducing in magnitude. In columns 2 and 3, we omit both country and time fixed-effects. However, our test of the joint significance of time effects (period dummies) suggests that they are statistically significant. Hence, we include time effects in our pooled OLS estimates in column 4. In column 5, we allow for country heterogeneity, opting for a Random-effects Model instead of a Least Squares Dummy Variable Model since the former is computationally more efficient (Verbeek, 2004). Furthermore, our Lagrange Multiplier test (Breusch-Pagan test) for panel (country) heterogeneity suggests that a Random-effects Estimator better fits the data compared to a naïve pooled OLS. Thus, in column 5, a percentage point increase in resource revenues is associated with an eviction effect of about 0.2 percentage points in non-resource tax effort.

From columns 3 through 5 of Table 4, only GDP per capita turns out statistically significant across all specifications. GDP per capita is positively correlated with non-resource tax effort. An increase in agriculture value-added is negative correlated with non-resource tax effort in all three specifications but only statistically significant in columns 3 and 4. Control of corruption is positively correlated with non-resource tax effort. The coefficient on control of corruption is also statistically significant at the 1 percent level in column 3 and 4. The coefficient on trade openness alternates in sign although it is only statically significant and negative in column 4 of Table 4.

In Table 5, we explore the fixed effect estimations further. Columns 1 and 3 of Table 5 are results of a Random-effects Estimator (henceforth REE) with and without time effects. Columns 2 and 4 present results of a Fixed-effects Estimator (henceforth FEE) which allows for correlation between unobserved effects and the right-hand side variables. The specification in column 5 of Table 4 is repeated in column 3 of Table 5 for purposes of comparison of the two specifications for the REE.

Table 5: Random-effects (REE) and Fixed-effects (FEE) Estimation

Dependent Variable: Non-resource tax as a percentage of GDP				
VARIABLES	(1) REE	(2) FEE	(3) REE	(4) FEE
tot_resrev	-0.188*** (0.0487)	-0.157*** (0.0538)	-0.198*** (0.0412)	-0.163*** (0.0469)
grants	0.0373 (0.103)	0.0350 (0.105)	-0.00154 (0.0926)	0.00803 (0.0916)
Corrupt control	0.170 (0.274)	0.202 (0.302)	0.615 (0.388)	0.538 (0.403)
agricval2GDP	-0.0124 (0.0677)	0.00347 (0.0759)	-0.0137 (0.0691)	0.00446 (0.0792)
Log GDP per capita	2.613*** (0.771)	3.305** (1.263)	1.698** (0.737)	1.962 (1.423)
Trade openness	0.00886 (0.0105)	0.00768 (0.0114)	0.00314 (0.0106)	0.00363 (0.0121)
Country Effect	Yes	Yes	Yes	Yes
Time Effect	No	No	Yes	Yes
Observations	1,069	1,069	1,069	1,069
R-squared		0.139		0.187
Number of id	66	66	66	66

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Hausman Test for columns (1) and (2)

Test: Ho: difference in coefficients not systematic)¹⁹

$$\chi^2(6) = (b-B)'[(V_b - V_B)^{-1}](b-B)$$

$$= 38.41$$

$$\text{Prob}>\chi^2 = 0.0000$$

(V_b-V_B is not positive definite)

¹⁹ Where “b” and “B” represent fixed-effects and random effects parameters respectively

On the whole, an offset of approximately 0.2 percentage points of GDP in non-resource taxes is associated with a percentage point increase in resource revenues. This result is similar to Bornhorst et. al. (2009), who find an offset of similar magnitude for 30 hydrocarbon-producing countries. Their main outcome variable is, however, non-hydrocarbon revenues as a percentage of GDP while the main explanatory variable is hydrocarbon revenues. As a robustness check, we test for the inherent assumption associated with the REE estimator that the unobserved effects (country heterogeneity) are exogenous and thus not correlated with the other regressors. A violation of this assumption would render the results inconsistent due to omitted variables. The test provided by (Hausman, 1978) then essentially pits a null hypothesis that there is no systematic difference in coefficients between the REE and FEE against the alternative that a systematic difference exists. The Hausman test rejects the null hypothesis of no systematic difference hence our FEE estimator becomes preferable (see test results below Table 5). This result is maintained with or without the inclusion of period dummies. Thus, for the preferred specification in column 4, a percentage point increase in resource revenues is associated with a 0.16 percentage points decline in non-resource taxes.

The next set of specifications account for the fact that the impact of natural resource revenues on development outcomes could take time to manifest, at least beyond a calendar year. In addition, we allow for persistence in the outcome variable thereby accommodating the effect of shocks to last for more than a year. For example, it is plausible to expect a shock to non-resource taxes due to an economic crisis that last beyond a year. In order to account for these dynamics, the data is transformed into non-overlapping five-year averages (a semi-decadal series). The transformation allows for assessing the medium-term effect of resource revenues on non-resource taxes. Columns 1 through 5 of Table 6 present the medium-term effects.

Table 6: Medium-term Effects – Panel OLS and Fixed-effects Specification

	(1)	(2)	(3)	(4)	(5)
Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	OLS	OLS	OLS	REE	FEE
tot_resrev	-0.426*** (0.0245)	-0.370*** (0.0236)	-0.419*** (0.0357)	-0.295*** (0.0391)	-0.171*** (0.0611)
grants		-0.00955 (0.0335)	-0.0603 (0.172)	0.0824 (0.182)	0.127 (0.197)
Corrupt control			1.997*** (0.398)	0.925** (0.435)	0.682 (0.471)
agricval2GDP			-0.141*** (0.0443)	-0.0442 (0.0631)	0.0222 (0.0937)
Log GDP per capita			0.675 (0.457)	1.326** (0.665)	1.132 (1.305)
Trade openness			-0.00112 (0.00791)	0.00571 (0.0103)	0.0112 (0.0135)
Country Effect	No	No	No	Yes	Yes
Time Effect	No	No	No	Yes	Yes
Observations	546	409	253	253	253
Number of id			67	67	67

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Starting from column 1, the list of control variables is included additively. The specification in column 2 controls for grants as a percentage of GDP. Column 3 includes the full list of regressors but without fixed-effects. The Random-effects and Fixed Effect Estimators are introduced in columns 4 and 5 respectively and with time effects. Once again, a Hausman test rejects the null hypothesis of a non-systematic difference between the REE and FEE. The latter becomes the preferred choice. In the medium-term, the effect of resource revenues on non-resource taxes appears to be more adverse across all specifications compared to the short-term effect captured in Table 5. The medium-term effect suggests that a percentage point increase in resource revenues offsets non-resource tax effort by about 0.17 percentage points. The effect is statistically significant at the one percent level. The effect of grants and trade openness are not statistically significant across specifications. The coefficient on corruption is positive and statistically significant in the third and fourth columns but not in our preferred specification in column 5. Similarly, the coefficient on log GDP per capita is positive and significant in the

fourth specification but not in the third and fifth specifications. Finally, the effect of agriculture-value added as a percentage of GDP (also a measure of the level of informality) has a negative and statistically significant effect on non-resource tax effort in the third column. This effect is however muted in the fourth and fifth columns.

2.4.3 A Causal Effect Using a Generalized Method of Moments Estimator

Although applying a fixed-effects estimator on the transformed data (i.e. non-overlapping five-year series) addresses a potential persistence in the data, it is unable to adequately tackle another potential problem of endogeneity that undermines our model - reverse causation. Countries that have very low non-resource tax base or deficient (non-resource) tax capacity and therefore low non-resource revenues are more likely to depend on the natural resource sector. Similarly, it is not unreasonable to expect that countries with a poor domestic resource base are more likely to be prone to corruption or attract grants. Thus, not only is the main explanatory variable (resource revenues as a percentage of GDP) potentially endogenous, other covariate such as grants and corruption may suffer from the same problem. To correct for this, we apply an Arellano and Bond estimator to the transformed data series following Bond, Hoeffler, & Temple, (2001). The application of a GMM estimator lies in its strength to instrument for potentially endogenous variables such as the aforementioned. Columns 1 through 5 in Table 7 feature both a difference GMM (i.e. columns one and two) and a system GMM estimator (columns 3 through 5). While a difference GMM estimator is sufficient for addressing the concerns enumerated above, a system GMM estimator provides an additional advantage as it handles dynamic models better. The systems GMM estimator has better finite sample properties and uses additional instruments within a system of equations to correct for endogeneity (Roodman, 2008; Bond et al., 2001). Columns 1 and 2 apply a one-step difference GMM estimator while columns 3 to 5 specify a two-step GMM estimator. The specifications

in column 2, 4 and 5 accommodate time effects as additional exogenous instruments. Besides the lagged dependent variable, *Corrupt control* is specified as endogenous and thus instrumented for across all specifications. In column 5, we specify grants as a percentage of GDP as an additional endogenous variable.

Table 7: Generalized Method of Moments Estimator for a Semi-Decadal Series

Dependent variable: Non-resource tax as a percentage of Gross Domestic Product (GDP)					
VARIABLES	(1) DIFF	(2) DIFF	(3) SYS	(4) SYS	(5) SYS
tot_resrev	-0.123* (0.0703)	-0.134** (0.0614)	-0.171** (0.0667)	-0.116 (0.0694)	-0.117** (0.0475)
(Nonres_tax) _{t-1}	-0.0177 (0.215)	0.0275 (0.266)	0.629*** (0.168)	0.762*** (0.193)	0.755*** (0.132)
grants	0.0692 (0.143)	0.000234 (0.139)	0.0500 (0.102)	0.121 (0.138)	-0.00492 (0.236)
Corrupt control	0.0481 (0.590)	0.482 (1.132)	-0.573 (0.498)	-0.482 (0.768)	-0.335 (0.688)
agricval2GDP	-0.0694 (0.0599)	-0.0985 (0.0658)	-0.0564 (0.0451)	-0.0549 (0.0404)	-0.0421 (0.0401)
Log GDP per capita	1.699 (1.066)	0.977 (1.470)	0.710 (0.621)	0.350 (0.515)	0.352 (0.403)
trade2GDP2	0.00980 (0.0101)	0.00560 (0.0116)	0.00540 (0.00686)	0.00317 (0.00427)	0.00285 (0.00389)
Time effect	No	Yes	No	Yes	Yes
No. of instruments	14	19	24	29	38
Observations	164	164	229	229	229
Number of id	53	53	65	65	65
AR(1) (P-values)	0.62	0.71	0.02	0.04	0.031
AR(2) (P-values)	0.32	0.24	0.46	0.88	0.87
Hansen J (P-values)	0.35	0.08	0.22	0.27	0.6
Diff-in- Hansen test	0.36	-	0.51	0.17	0.43

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Lag of non-resource tax and corruption are instrumented for in columns 1 through 4. In column 5, we instrument for the grants variable in addition.

Except for column 4, the parameter of interest remains negative and statistically significant at conventional levels across all specifications, albeit with caveats for some specifications. The underlying evaluation diagnostics for serial correlation for the specifications in columns one and two suggest that the test of no first-order autocorrelation was not rejected. Furthermore, the lagged effects of non-resource taxes do not turn out statistically significant at conventional

levels. This constitutes a weakness for the first two specifications. In columns 3 through 5 however, the evaluation diagnostics across the specifications appear more credible. The test of no first-order autocorrelation is rejected. The lagged effects are positive and statistically significant. The Hansen J and Difference-in-Hansen test statistics suggest that our overidentifying restrictions are valid. In other words, the set of instruments are credible (Parente & Santos Silva, 2012). None of the control variables turn statistically significant. In column 3, a percentage point increase in resource revenues offsets non-resource taxes by about 0.17 percentage points (similar to our preferred specification in column 5 of Table 6). Column 5 is a more preferred specification relative to column 3 given that we account for possible impact of global shocks in the former case. Still in column 5, we account for the possibility that countries with persistent low non-resource tax revenues may attract or depend on grants. The result in column 5 shows a reduced eviction effect of resource revenues on non-resource taxes of about 0.12 percentage points in the medium-term, with accounting for multiple endogenous variables. The specification in column 5 also signals the importance of controlling for the persistence in tax revenue performance. Subsequently, we discuss a number of conditions within a country that could possibly drive the observed negative relationship.

First, governments' attempt to take advantage of a new find or commodity boom by introducing new taxes in the form of say a windfall tax (Deaton and Miller, 1995) or a tax on investment, may have unintended consequences. If not properly designed and applied, the tax regime could scare away potential investors and undermine the quest for promoting a business-friendly environment. The situation could also cause the private sector to adopt a wait-and-see attitude thereby discouraging new investments. Such a development does not only affect the resource sector but also undermines the expansion of the non-resource sector and therefore the potential for mobilizing non-resource revenues. More so, austere fiscal regimes have a tendency to

promote transfer mispricing, tax evasion and tax avoidance. Another reason why a displacement effect of resource revenues on non-resource tax effort is plausible could be as a result of duality in a tax revenue management system. This would be a situation where different fiscal regimes exist between the resource and non-resource sectors. For instance, developing countries may devote more attention to a new resource sector, where an appropriate fiscal regime might be introduced in a bid to get the most out of the sector. The latter may co-exist with a relatively weaker system in the non-resource sector (Venables, 2016). Revenue performance between the two sectors may vary as a result, with the non-resource sector getting less attention. In the case of developing countries, this would be partly due to structural challenges relating to informality and productivity in the wider non-resource sector.

Additionally, a boom in natural resource rents could inform a public policy decision to transfer these rents to the private sector through subsidies or generous tax incentives. In some instances, new companies are provided generous incentives in advance of production in order to recover costs already expended. In the short-term, this could dampen non-resource revenues. The situation of low non-resource tax revenues can persist if the binding constraints within the non-resource sector are the kind that go beyond providing generous tax incentives. Nakyea & Amoh (2018) use Ghana as a case study to demonstrate how generous tax incentives do not necessarily translate to increased flows of foreign direct investment while rather reducing domestic revenue potential of a resource-rich country. An incumbent government might also provide generous tax incentives using resource rents, rather than broadening the tax base, as a way of avoiding citizens' demand for accountability (Ossowski & Gonzales, 2013; Brautigam, Fjeldstad, & Moore, 2008; Moore, 2007).

Apart from the tax policy effects described above, there could also be the tax capacity effect. The theoretical argument is articulated by Besley & Persson (2013). In a country with a constrained human resource base, a booming resource sector attracts talent (highly skilled human capital) away from the non-resource sector. This leaves the human resource base in the non-resource sector severely constrained and diminished. Among institutions that suffer from the effect of human resource movement are the state revenue authorities. During resource booms, domestic revenue institutions are sometimes reorganized to suit various purposes. As indicated earlier, one reason could be to maximize resource revenues. There are also instances where resource booms birth a new resource politics. For instance, Chaudhry's work traces and documents Saudi Arabia's development of tax capacity before and after the oil boom in the 1970s (Chaudhry, 1997; Knack, 2009). The trajectory of improvement in tax capacity between 1930 and 1973 took a different turn when several billions of dollars in oil revenue began to accrue to the government. The boom was triggered by the quadrupling of international oil prices in 1973. As a policy response, most of the offices of the Department of Zakat (religious tithe) and Income Tax was closed during these boom years. The Yemeni government followed a similar path in dismantling a key part of its fiscal infrastructure. When oil prices plummeted in the early 1980s, both governments had to resort to inefficient and austere policies including retroactive taxation, which could not be sustained (Chaudhry, 1997). Lim (1988) also notes that resource-rich countries usually have poor capacity to collect taxes.

The explanations so far however only reveal local factors within an economy. This only presents a limited scope in attempts to understand the fiscal resource curse. For instance, Poelhekke & Van der Ploeg (2013) find that foreign direct investment flows into the natural resource sector of resource-rich countries displace foreign direct investment to the non-resource sector. This effect is not only seen when a non-resource country discovers natural

resources but also during price booms in countries that already have a natural resource sector (Van Der Ploeg & Poelhekke, 2017). Thus, in practice, countries are exposed to various geopolitical and economic dynamics, sometimes foreign borne, that impacts on what happens to their fiscal capacity within their territories.

In the next section, we explore the role of China's rise in natural resource trade in the aftermath of her accession to the World Trade Organization in 2001. This approach accounts for a very important factor in natural resource trade that have not been expressly or adequately accounted for in the fiscal resource curse literature.

2.4.4 A Two-Stage Least Squares (2SLS) Instrumental Variable Approach - Global Sample

We construct and deploy a variant of the 'China shock' as an instrument for the main explanatory variable: resource revenues as a percentage of GDP. 'China shock' represents an interaction term between two variables: China's non-renewable resource imports (fuels, ore and metals) as a percentage of GDP and a time dummy reflecting China's accession to the World Trade Organization (WTO). The WTO period dummy takes a value of one for all periods after 2001 and a value of zero otherwise. The variable 'China_Resimp' refers to China's non-renewable resource imports as a percentage of GDP, one of the constituents of the interaction term. Columns 1 through 4 of Table 8 presents the first-stage regression results with the full list of control variables. They include specification with or without WTO time dummies. Columns 1 and 3 specify 'China shock' as the only instrument for resource revenues as a percentage of GDP while columns 2 and 4 include 'China_Resimp' as an additional instrument. We provide results of validity tests for the instruments.

In the first-stage regression, the coefficient on the instruments turn positive and statistically significant at conventional levels across all four specifications. A test of validity of the instrument for the just identified restrictions specified in columns 1 and 3 of Table 5 produce F-values of 4.84 and 19.14 respectively. In columns 2 and 4, the test for joint validity of instruments yield F values of 8.26 and 23.43 respectively.

Table 8: First Stage Regression – Global Sample

Dependent Variable: Resource revenues as a percentage of GDP				
	(1)	(2)	(3)	(4)
Variables				
China shock	0.184** (0.084)	0.741*** (0.202)	0.427*** (0.098)	1.171*** (0.296)
China_Resimp		-0.680*** (0.254)		-1.325*** (0.308)
Corrupt control	-0.289* (0.168)	-0.097 (0.190)	-0.508*** (0.184)	-0.310* (0.187)
Log GDP per capita	-2.439* (0.168)	-2.144 (1.306)	-2.213* (1.273)	-1.456 (1.321)
agricval2GDP	-0.351*** (0.056)	-0.352*** (0.571)	-0.361*** (0.057)	-0.371*** (0.059)
WTOtime			-1.833*** (0.505)	-3.317*** (0.635)
[Joint] F test	4.84	8.26	19.14	23.43
Country effect	Yes	Yes	Yes	Yes
Observations	1,025	1,025	1,025	1,025
R-squared	0.816	0.885	0.920	0.924
No. of countries	66	66	66	66

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

In general, specifications with F-values above the benchmark of 10 is preferable as they are relatively more robust (Stock, Wright, & Yogo, 2002). These are specifications in the columns 3 and 4 in Table 8. However, even with positive F-values below 10 in just-identified models, weak instruments need not be dismissed. The conditions that need to be satisfied are as follows: the coefficient of the instrument at the first stage is not zero, is statistically significant at conventional levels and of the expected sign (Angrist & Pischke, 2008 ; Angrist & Pischke,

2009). The effect of weak instrument translates to larger standard errors at the second stage.

The estimated effect, however, remains unbiased.

Table 9: Second Stage Regression – Global sample

Dependent variable: Non-resource tax as a percentage of GDP				
VARIABLES	(1)	(2)	(3)	(4)
tot_resrev	0.620 (0.428)	0.307 (0.207)	0.000755 (0.135)	-0.0706 (0.122)
Corrupt control	0.598** (0.260)	0.439** (0.193)	0.522*** (0.171)	0.482*** (0.156)
Log GDP per capita	4.382*** (0.998)	3.959*** (0.741)	2.765*** (0.553)	2.679*** (0.555)
agricval2GDP	0.290* (0.153)	0.176* (0.0898)	0.0770 (0.0625)	0.0509 (0.0641)
WTOtime			0.859*** (0.276)	0.847*** (0.263)
Country effect	Yes	Yes	Yes	Yes
China shock1	Yes	Yes	Yes	Yes
China_Resimp	No	Yes	No	Yes
Observations	1,025	1,025	1,025	1,025
R-squared	0.816	0.885	0.920	0.924
No. of countries	66	66	66	66

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients in the model is preserved.

The second stage regression results corresponding to the first stage regression in Table 8 are displayed in columns 1 through 4 of Table 9. Like Table 8, Table 9 makes use of the full sample of countries with available data as well as the full list of controls. Except for the fourth column, the second stage regression estimates show positive coefficients across all specifications on the effect of resource revenues on non-resource taxes, once we account for the China shock. The effects, however, turn out to be statistically insignificant at conventional levels across all four specifications. Thus, the hypothesis that China’s resource trade after her entry into WTO might have had a positive impact on resource exporting countries, on average, through the positive effect on tax revenues from the non-resource sector is not supported by the evidence, using a global sample. While the results may be attributed to the strength of our instrument, a more

plausible explanation would be the sample of countries under consideration. Developed countries have diversified their economies away from the traditional natural resource sector. This is also the case for an increasing number of emerging economies. These countries rely less on natural resources for their development and therefore have weak links with China as far as resource trade is concerned. China's influence on the global trade in natural resources is felt much more among developing regions in SSA, Latin America and Asia (Alemayehu, 2018; Vasquez, 2018; Lin & Wang, 2016). The resource sector often forms a lion's share of the export sector as well as the total revenue envelope of these economies. China's entry into the WTO and resource imports is thus likely to be felt more in these economies.

We test for the above hypothesis in the following sections, beginning with the exclusion of a set of outliers. First, we drop a set of developed countries which are classified as among the highest per capita income earners from the global sample used for the estimations in Tables eight and nine. The list of countries includes USA, Norway, Sweden, Iceland, Netherlands, Lithuania and Hong Kong (China)²⁰.

Table 10: First Stage Regression (Excluding the set of Advanced Economies)

Dependent variable: Resource revenues as a percentage of GDP				
	(1)	(2)	(3)	(4)
VARIABLES				
China shock1	0.163* (0.095)	0.760*** (0.218)	0.473*** (0.116)	1.762*** (0.3)
China_Resimp		-0.724*** (0.272)		-1.335*** (0.311)
Corrupt control	-0.326** (0.176)	-0.116 (0.20)	-0.596*** (0.194)	-0.371* (0.199)
Log GDP per capita	-2.403** (1.355)	-2.088 (1.383)	-2.146 (1.340)	-1.410 (1.380)
agricval2GDP	-0.350*** (0.056)	-0.349*** (0.057)	-0.361*** (0.057)	-0.367*** (0.059)

²⁰ Hong Kong is politically part of China however the structure of its economy is distinct from the mainland. Consequently, several data sources separate data on Hong Kong from that of mainland China.

WTOtime			-2.311*** (0.586)	-3.70*** (0.683)
[Joint] F test	2.92	6.8	16.83	21.99
Country effect	Yes	Yes	Yes	Yes
Observations	882	882	882	882
R-squared	0.816	0.885	0.920	0.924
No. of countries	58	58	58	58

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

Columns 1 through 4 of Table 10 present the first stage regression. Once again, the coefficient on the instruments turns out positive and statistically significant at conventional levels. China’s resource imports after joining the WTO have a positive effect on resource revenues, holding other factors constant. The F -test for validity of the instruments remain consistently positive and above the benchmark level of 10 for columns 3 and 4 of Table 11.

Table 11: Two-stage Least Squares Approach: Second Stage (Excludes a set of advanced economies)

Dependent variable: Non-resource tax revenue as a percentage of GDP				
	(1)	(2)	(3)	(4)
VARIABLES				
tot_resrev	1.257 (0.867)	0.618** (0.285)	0.0802 (0.143)	0.0399 (0.124)
Corrupt control	0.938** (0.449)	0.610** (0.259)	0.721*** (0.185)	0.695*** (0.170)
Log GDP per capita	5.750*** (1.670)	4.806*** (1.022)	2.765*** (0.609)	2.721*** (0.607)
agricval2GDP	0.543* (0.299)	0.312*** (0.118)	0.139** (0.0655)	0.124* (0.0654)
WTOtime			1.419*** (0.315)	1.401*** (0.285)
Hansen J (P-value)		0.191		0.772
Country Effect	Yes	Yes	Yes	Yes
China Shock1	Yes	Yes	Yes	Yes
China_Resimp	No	Yes	No	Yes
Observations	882	882	882	882
R-squared	0.415	0.758	0.894	0.898
No. of countries	58	58	58	58

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

All coefficients in the second stage are positive although statistical significance is only realized in the second column of Table 11. What becomes obvious though is that the negative relationship between resource revenues and non-resource tax effort is not sustained once we account for China's role in global natural resource trade. Moreover, the fact that there are still several high-income countries in the sample besides the list that was excluded warrants further investigation. In the next section, we consider a more systematic approach by restricting the global sample to the World Bank's definition of developing countries, as a first step. Next, we examine the role of the China shock for Low-income and Lower-middle-income Countries. These restricted samples are defined on the basis of the World Bank's Income Classification of countries in 2017.

2.4.5 A Two-Stage Least Squares (2SLS) Instrumental Variable Approach - Case of Developing Countries

Tables 12 to 15 depict results on the role of the China shock in developing economies. Specifically, Tables 12 and 13 explore the case for all developing economies in the sample. The model specifications in columns 1 through 4 are maintained as previously.

Table 12: First Stage Regression - Developing Countries' Sample

Dependent Variable: Resource revenues as percentage of GDP				
VARIABLES	(1)	(2)	(3)	(4)
China Shock 1	0.101 (0.112)	0.377 (0.259)	0.540*** (0.144)	1.577*** (0.364)
China_Resimp		-0.338 (0.332)		-1.071*** (0.379)
Corrupt control	-0.315 (0.219)	-0.219 (0.251)	-0.771*** (0.256)	-0.633** (0.258)
Log GDP per capita	-1.384 (1.709)	-1.235 (1.748)	-1.397 (1.652)	-0.928 (1.684)
agricval2GDP	-0.334*** (0.0565)	-0.333*** (0.0570)	-0.354*** (0.0586)	-0.358*** (0.0599)
WTOtime			-3.199*** (0.727)	-4.366*** (0.847)
[Joint] F- test	0.81	1.36	14.04	14.17

Country Effect	Yes	Yes	Yes	Yes
Observations	633	633	633	633
No. of countries	45	45	45	45

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

The coefficient on the interaction term between China’s resource import and the WTO time dummy (i.e. China shock) is positive across all specifications as expected. The effect is statistically significant at conventional levels for the specifications in column 3 and 4 only. The latter are also characterized by F-values of 14.04 and 14.17 respectively, exceeding the minimum benchmark. The F-values for columns 1 and 2 are positive but much lower in magnitude, yielding the sizes of 0.81 and 1.36 respectively. The result further demonstrates the drawback of restricting the model in columns 1 and 2.

Table 13: Second stage regression - Developing countries

Dependent variable: Non-resource tax revenue as a percentage of GDP				
	(1)	(2)	(3)	(4)
VARIABLES				
tot_resrev	1.440 (1.818)	1.422 (1.040)	0.139 (0.159)	0.267* (0.158)
Corrupt control	0.901 (0.751)	0.894 (0.610)	0.628*** (0.208)	0.718*** (0.227)
Log GDP per capita	4.591** (2.170)	4.576** (2.185)	2.794*** (0.720)	2.796*** (0.854)
agricval2GDP	0.582 (0.589)	0.576 (0.353)	0.153** (0.0680)	0.199*** (0.0740)
WTOtime			0.954** (0.382)	1.089*** (0.365)
Hansen J (P-value)		0.99		0.41
Country Effect	Yes	Yes	Yes	Yes
China Shock	Yes	Yes	Yes	Yes
China_Resimp	No	Yes	No	Yes
Observations	633	633	633	633
R-squared	-0.081	-0.060	0.837	0.804
No. of countries	45	45	45	45

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

The low F-values in columns 1 and 2 of Table 12 are mirrored in Table 13, which show that the coefficients for those specifications are imprecisely estimated. The lack of precision of the model in columns 1 and 2 of Table 13 are also reflected in the centered R squared falling below the zero bound. Thus, the coefficient on resource revenues is positive but not statistically significant at conventional levels for both columns. Despite passing the instrument validity test, the just identified model in column 3 of Table 13 retains large standard errors. The coefficient on resource revenues is therefore not statistically significant from zero at conventional levels although it retains a positive sign. The most precisely specified model in column 4 of Table 13 passes both the instrument validity test as well as the Hansen J test of over-identifying restrictions with a P-value of 0.41. The instrumented coefficient of interest turns statistically significant at the 10 percent level. The result suggests a positive effect of the resource revenues on non-resource tax revenue mobilization effort in developing countries, once the China shock is accounted for.

Tables 14 and 15 further restrict the sample of countries to a combination of Lower-Middle-Income Countries and Low-Income Countries only. Table 14 presents the first-stage regression results. The model specification is consistent with those used in previous tables. Unlike the full developing countries sample, the coefficient on the instruments turn out statistically significant at conventional levels across all specifications for the sample of Lower-middle-income Countries and Low-income Countries. Once again, the validity tests suggest that the models in columns 3 and 4 of Table 14 are better specified. The F-values are 9.88 and 9.34 respectively.

Table 14: First Stage Regression - Low Middle-income Countries and Low-income Countries

Dependent variable: Resource revenues as a percentage of GDP			
(1)	(2)	(3)	(4)

VARIABLES				
China Shock	0.275*	0.668**	0.585***	1.459***
	(0.150)	(0.277)	(0.186)	(0.436)
China_Resimp		-0.464		-0.884*
		(0.393)		(0.456)
Corrupt control	-0.173	-0.0415	-0.419	-0.267
	(0.326)	(0.345)	(0.352)	(0.342)
Log GDP per capita	-5.053***	-5.004***	-4.809***	-4.618**
	(1.816)	(1.825)	(1.797)	(1.814)
agricval2GDP	-0.315***	-0.312***	-0.324***	-0.322***
	(0.0585)	(0.0593)	(0.0600)	(0.0609)
WTOtime			-2.167***	-3.037***
			(0.773)	(0.960)
[Joint] F-test	3.38	5.43	9.88	9.34
Country Effect	Yes	Yes	Yes	Yes
Observations	346	346	346	346
No. of countries	26	26	26	26

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

The corresponding second stage regression results in Table 15 show a positive coefficient on resource revenues. The effect is however not statistically significant except for our most preferred specification in the fourth column where the coefficient on resource revenues turns statistically significant at the 10 percent level. GDP per capita remains statistically significant at the 1 percent level across all specifications, indicating that it is an important determinant of non-resource tax effort. The coefficients of other remaining covariates in Table 15 are not statistically significantly distinguishable from zero. The key result, suggests that, once we account for the ‘China shock’, a percentage point increase in resource revenues augments non-resource tax revenues by about 0.3 percentage points. This effect is however statistically modest given its significance at the 10 percent level of confidence. The observed positive relationship between resources revenues and non-resource tax effort on the back of the exogenous shock to the global natural resource trade after year 2001 deserves further deliberation.

Table 15: Second Stage Regression for Lower-middle-income and Low-income Countries' Sample

Dependent variable: Non-resource tax revenue as a percentage of GDP				
VARIABLES	(1)	(2)	(3)	(4)
tot_resrev	0.0842 (0.281)	0.322 (0.213)	0.100 (0.179)	0.303* (0.175)
Corrupt control	-0.141 (0.205)	-0.0318 (0.248)	-0.142 (0.210)	-0.0579 (0.241)
Log GDP per capita	2.548*** (0.930)	3.323*** (0.870)	2.633** (1.051)	3.333** (1.289)
agricval2GDP	0.0267 (0.0915)	0.107 (0.0702)	0.0316 (0.0668)	0.0997 (0.0693)
WTOtime			-0.0309 (0.386)	-0.0673 (0.444)
Hansen J (P-value)		0.264		0.234
China Shock	Yes	Yes	Yes	Yes
China_Resimp	No	Yes	No	Yes
Country Effect	Yes	Yes	Yes	Yes
WTO Time Dummy	No	No	Yes	Yes
Observations	346	346	346	346
R-squared	0.805	0.736	0.802	0.743
No. of countries	26	26	26	26

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Grant and trade variables are “partialled out” in order to obtain full covariance matrix of orthogonal conditions necessary for an efficient estimator as well as subsequent overidentification tests. The effect of their inclusion on the coefficients above is however preserved.

The International Monetary Fund’s 2016 World Economic Outlook aptly summarized the effect of China’s influence on commodity trade following her accession to the World Trade Organization. Global commodity prices have reacted significantly leading to higher resource revenues in boom periods. Two key regions that have benefitted from China’s natural resource imports are Africa and Latin America, mostly dominated by lower-middle-income and low-income countries. In these regions, China’s engagement has been characterized by natural resource trade deals that do not necessarily amount to liquid capital flows. The resource trade relationship has evolved to an exchange that compensates for financial market and governance challenges in developing countries, while allowing for real sector diversification in resource-rich countries (Lin & Wang, 2016; Halland, Beardsworth, Land, & Schmidt, 2014). This has

taken the form of resource-for-infrastructure deals. In essence, China provides critical infrastructure needs in exchange for natural resources.

Conventional foreign direct investment (FDI) from China pales into comparison with credit lines along the resource for infrastructure deals (Alemayehu, 2018). China has offered special ‘loans’ and projects through her main lending arm – China EX-IM Bank. These are usually variants of a barter trade which involves exchange of natural resources for infrastructure projects²¹. Since 2007, over \$140 billion worth of Chinese loans reached the shores of Latin America to meet investment in either transport or energy infrastructure (Vasquez, 2018). By 2006, China’s investment in Africa’s Infrastructure had jumped from about \$1billion per annum to \$7billion per annum, falling slightly to \$4.5 billion in 2007 (Foster, Butterfield, Chen, & Pushak, 2008). Data from the Infrastructure Consortium for Africa (ICA) suggests that China is the leading creditor for infrastructure projects in Africa (ADB Group, 2016). These investments cover the areas of energy, transport, water and information and communication technology. Countries such as Nigeria, Angola, Ethiopia and Sudan have been the largest beneficiaries. More than 35 countries including Democratic Republic of Congo and Ghana continue to benefit from such deals (Foster et al., 2008). The upshot is that China is leveraging her massive capacity in infrastructure provisioning to easing binding constraints facing many developing countries.

Lin & Wang (2016) describe resource for infrastructure investments as “bottleneck-releasing” and a means to “crowd-in funding”. Various studies suggest that infrastructure gaps remain a key binding constraints for firm growth and productivity in developing countries (Abeberese,

²¹ Zongwe (2010) however argues that these natural resource deals bear the features of an investment contract and not trade deals. Per this view, investment contracts depict a long-lasting partnership that could last for decades.

2019; Akpandjar & Kitchens, 2017; Allcott, Collard-Wexler, & O’Connell, 2016). Provision of transport and energy (electricity) infrastructure releases bottlenecks that significantly drives down transaction costs and potentially increases revenues. Moreover, countries with better infrastructure are more likely to attract investment, a crowding-in factor that can also trigger a multiplier effect. The tendency for capital flight is reduced and future decision-makers have a default commitment mechanism for accumulating assets (Halland et al., 2014). Therefore, the resource-for-infrastructure trade model has a potential for leveraging infrastructure development as a means of expanding the non-resource sector, expanding the non-resource taxable base and by extension improving the level of non-resource taxes mobilized.

Our key result in Table 15 conveys the message that benefits from a thriving natural resource sector need not displace domestic tax revenues in the non-resource sector. The role of infrastructural development through natural resource trade is key to this result. The modesty that should go with the interpretation of our result lie in the following: First of all, it will be naïve to expect that China’s resource trade model would automatically convey positive benefits on non-resource tax outcomes in every case. The Chinese resource trade model is not equal in size and scale among the developing countries in our sample. While the number of countries partnering with China has been increasing, the large volume of transactions has been concentrated on fewer countries. Moreover, concerns have been raised about the nature of contracts alongside how they are implemented. Transparency around the contracts is an issue that has been raised by civil society organizations while some governments have described it as debt-trap diplomacy. The risk of opaque contracts on infrastructure projects is that there is greater likelihood for their revocation or review if new governments that take over power in these countries feel dissatisfied.

Another concern that has emerged is the fact that, in some countries, bidding for contracts is dominated by Chinese companies to the detriment of local content and broader participation. An oft-cited example is the Angola Model. The resource-for-infrastructure (henceforth R4I) deal was struck between China and Angola in the year 2004 following decades of conflict in the latter, which ended in 2002. This was at a time when traditional donors such as the OECD, World Bank and IMF were hesitant to lend to Angola given its post-conflict status (Zongwe, 2010). Angola benefited from about US\$4.5 billion worth of post-conflict infrastructure investments, exporting thousands of barrels of oil per day to China in return (Ibid). About 30 percent of the project was subcontracted to local companies although there are claims that some of these local companies were jointly owned with the Chinese. The cost of borrowing under R4I has also been raised as important for the borrowing countries. There is a fear that countries risk running into a debt crisis under these deals. Finally, concerns about the quality of some of the infrastructure raises the importance of project monitoring and evaluation towards ensuring the best value for money.

2.4.6 Further Robustness Checks for Baseline Model (Equation 1)

Despite the analysis in the preceding sections, a concern can be raised about the validity of the baseline model specified in equation 1. A question arises on whether the relationship between resource revenues and non-resource tax effort can be non-linear. Additionally, one might wonder whether introducing other control variables could affect the results. To check the robustness of the estimates from our base model, first, we investigate whether there is a non-linear relationship between resource revenues and non-resource tax effort. The result is presented in column 1 of Table 16. From column 2 through 5 of Table 16, we include a list of additional control variables to our base model. We examine the sensitivity of our results to the

inclusion of additional control variables: quality of political institutions, constraint of the executive, inflation and population.

Table 16: Robustness checks with non-linear term and alternative covariates

Dependent variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) FEE	(2) FEE	(3) FEE	(4) FEE	(5) FEE
tot_resrev	-0.295*** (0.104)	-0.178*** (0.0514)	-0.178*** (0.0516)	-0.127* (0.0636)	-0.187*** (0.0436)
c.tot_resrev#c.tot_resrev	0.00287* (0.00166)				
grants	-0.00181 (0.0934)	0.00882 (0.0915)	-0.000956 (0.0919)	0.0530 (0.0995)	0.0798 (0.0950)
Corrupt control	0.577 (0.398)	0.443 (0.465)	0.439 (0.436)	0.841** (0.362)	0.535 (0.370)
agricval2GDP	-0.00251 (0.0799)	-0.0256 (0.0754)	-0.0255 (0.0751)	-0.00720 (0.0725)	-0.00427 (0.0748)
Log GDP per capita	2.324 (1.488)	1.878 (1.472)	1.829 (1.447)	3.509** (1.712)	4.384*** (1.583)
trade2GDP2	0.00484 (0.0120)	-0.0107 (0.00899)	-0.0111 (0.00879)	0.00480 (0.0126)	0.0139 (0.0137)
polity2		-0.00771 (0.0674)			
exconst			0.00925 (0.00785)		
lnapi				-0.577 (0.498)	
lnpop					12.69*** (3.624)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	1,069	978	978	973	1,069
R-squared	0.195	0.166	0.168	0.204	0.272
Number of id	66	62	62	65	66

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The augmented specifications in columns (1) to (5) of Table 16 compares favourably with the baseline results in Tables five and six, despite the inclusion of a squared term of the explanatory variable as well as the inclusion of additional covariates in Table 16. In column (1) of Table 16, the squared term of the resource revenue variable turns statistically significant at the 10

percent level. We evaluate the turning point where the effect of resource revenue on non-resource tax effort turns positive. The effect of resource revenues on non-resource tax effort is given by:

$$\frac{\partial(R^{NR}/Y)_{it}}{\partial(R^{RR}/Y)_{it}} = -0.295 + 2(0.00287)\left(\frac{R^{RR}}{Y}\right)_{it} \quad (1b)$$

The effect of resource revenues on non-resource tax effort at the sample mean (of resource revenues) becomes $-0.295 + 0.00574(6.3) = -0.258$, which is negative. At the turning point, however, equation (1b) turns to zero. Thus,

$$\frac{\partial(R^{NR}/Y)_{it}}{\partial(R^{RR}/Y)_{it}} = -0.295 + 0.00574\left(\frac{R^{RR}}{Y}\right)_{it} = 0 \quad \text{and} \quad \left(\frac{R^{RR}}{Y}\right)_{it} = 51.39.$$

This result suggests that beyond a resource revenue to GDP level of 51.39 percent, the effect of resource revenue on non-resource tax effort turns positive. For this level of resource revenue as a percentage of GDP, there are only 5 countries in the sample that qualify: Saudi Arabia, Libya, Timor Leste, Kuwait and Qatar. These countries are also mostly the outliers in the sample. Thus, evidence of a non-linear relationship between resource revenues and non-resource tax effort is not robust. Furthermore, the coefficients of resource revenues as captured in columns 2 through 5 of Table 16 are not qualitatively different from the random-effects and fixed-effects estimates in Table 5. The only additional control variable which turns out statistically significant is population, which is positively associated with non-resource tax effort. In effect, a larger population is positively correlated with a higher potential for mobilizing non-resource tax revenues. Thus, we can conclude that the evidence of a non-linear relationship between resource revenues and non-resource tax effort is not strong. Our linear specification in equation 1 is therefore appropriate (see also Bornhorst et al., 2009).

2.5 Chapter Summary

In this empirical chapter, we investigate the validity of a variant of the fiscal resource curse. The latter conveys the idea that countries that have non-renewal natural resources perform poorly in mobilizing non-resource taxes. In effect, we examine whether natural resource revenues displace non-resource tax effort. The study uses a new global dataset on resource and non-resource revenues developed by the International Centre for Taxation and Development and currently hosted by UNU-WIDER. With data covering over a hundred countries for the period 1980 to 2015, we test for both static and dynamic relationships between resource revenues and non-resource tax effort using panel econometric techniques. What is novel in this study is that we exploit a variant of the so-called ‘China shock’ within a Two-Stage Least Squares instrumental variable framework to explore the relationship. We define the ‘China shock’ as our exogenous instrument, which interacts China’s total non-renewable natural resource imports as a percentage of GDP with a time dummy that indicates the country’s active participation in global trade after year 2001 when the country joined the World Trade Organization (WTO). China’s trade model was effected through the so-called resource-for-infrastructure deals. Basically, China provides infrastructure in lieu of non-renewable natural resource exports from developing countries. Our identification strategy stems from the fact that China’s global demand for natural resource imports constituted a global trade shock following her accession to the WTO in 2001. This transition has been unrelated to non-resource tax effort in developing countries.

Our results suggest that the evidence of a displacement effect of natural resource revenues on non-resource tax effort is neither consistent, conclusive nor a *fait accompli*, once one accounts for the ‘China shock’. We find that, after assuming membership of the World Trade Organization, China’s natural resource trade strategy with developing countries may have

conferred some positive benefits on non-resource tax effort. A percentage point increase in non-renewable natural resource revenues has led to a 0.3 percentage point increase in non-resource tax revenues as a percentage of GDP. The evidence is only statistically significant at the 10 percent level. Through the resource-for-infrastructure deals, China's investment in critical social and economic infrastructure may have contributed to improving the environment for doing business and expanding the non-resource tax base in resource-rich developing countries. The effect of these infrastructure investments in Low-income and Lower-middle-income Countries may be contributing to reversing the fiscal resources curse.

The Hartwick rule suggests that countries should invest a part of their revenues from natural resources into the development of other forms of capital. Such investments should yield returns as it contributes to diversifying the economy and expanding the tax base. The prospects of maintaining a smooth tax rate and securing expanded revenue base long after the natural resources are depleted should merit the attention of policymakers.

CHAPTER THREE

3.0 ROLE OF INSTITUTIONS IN MEDIATING THE RELATIONSHIP BETWEEN NATURAL RESOURCES AND NON-RESOURCE TAX REVENUES

In this chapter, we examine the extent to which different types of institutions mediate the relationship between natural resource rents and non-resource tax effort. There are 5 sections

spanning a literature review, a theoretical framework, an empirical framework and a presentation of results and discussions. The final section provides a chapter summary.

3.1 Literature Review

3.1.1 Introduction: an overview of the concept of ‘institutions’

The term ‘institutions’ has been used variously in the literature. Researchers, policymakers and other actors demonstrate different understandings of the term. Sometimes, different terms have been used to convey the same concept. Some of the words and phrases include laws, regulations, system of languages, organizations responsible for enforcement of contracts, rules, behavioural traits, norms and social customs, just to mention a few. Furthermore, different methods have been proposed to unpack the concept of institutions. These include studying its nature, origins and evolution (see for example Aoki (2001) and Greif (1998)). The differences in the understandings, and use of the term ‘institutions,’ have been a subject of scholarly debate over many decades. Many have expressed concern with the lack of clarity in the use of the term (Hodgson, 2015; Hindriks & Guala, 2015; Searle, 2005; Ostrom, 1986). Part of the reason is the fact that no discipline has a monopoly over the use of the term (Hodgson, 2004)²². Even in the field of economics different terms are used, with each considered to be mutually-exclusive (Greif, 2006). Expressing her concern with the different referents even in the same discipline, Elinor Ostrom, until recently, the only female Nobel Laureate in Economics, notes, “We cannot communicate effectively if signs used by another scholar in a field have different referents than the same signs used by another scholar in the same field” (Ostrom, 1986 pg. 4). That notwithstanding, both economists and non-economists²³ have made significant contributions

²² Embracing a multidisciplinary perspective, Hodgson (2004) provides a historical account on the evolution of Institutional Economics.

²³ For instance, Emile Durkheim, arguably the founding father of modern sociology is said to have defined sociology as a “science of institutions”.

to defining frameworks for developing a shared understanding of the concept of institutions (Hodgson, 2015; Hindriks & Guala, 2015; Greif, 2006; Searle, 2005; North, 1991; North, 1990; Ostrom, 1986; Schotter, 1981; Riker, 1980; Coase, 1960).

Riker (1980, pg. 4) defines institutions as “the rules about behaviour, especially making decisions”. Also emphasizing on rules, Douglas North defines institutions as “... the rules of the game in a society or, more formally, are the human devised constraints that shape human interaction” (North, 1990, pg.3). According to him, they can be formal or informal, written or unwritten. North (1990) makes a distinction between institutions and organizations. Ranging from the realm of amateur sports to business, institutions define rules for interaction while organizations are to be seen as players in the game²⁴. Elinor Ostrom also emphasizes on rules. She defines rules as prescriptions (either required, prohibited or permitted) commonly known and used to achieve order and predictability in any defined context (Ostrom, 1986). Extending this view in an earlier paper, Schotter (1981) highlights the role of agents (players of the game) and their interactions with the rules. For him, [social] institutions are “... not rules of the game but rather the alternative equilibrium standards of behaviour or conventions of behaviour... We care about what the agents do with the rules, not what the rules are” (Schotter, 1981; pg. 4). Rather than seeing Schotter’s definition as a contrarian position, one can view it as an attempt to place emphasis on what North refers to as ‘defacto’ institutions, the outcome of actual interactions or what agents actually do.

In a more recent effort, Hodgson (2015) defines institutions as an “integrated system of rules that structure social interactions” (Hodgson, 2015; pg. 501). What is noteworthy about his

²⁴ There are however those who include organizations as part of the definition of institutions. See for instance, Grafe & Gelderblom (2010) as well as Arkadie (1990) for a discussion on this.

definition is that, rather than assuming, he clarifies a definition of rules to include norms and social behaviour as well as legal rules (formal constraints that are codified – for example, laws)²⁵. Similarly, Voigt (2013) defines institutions as “commonly known rules used to structure recurrent interaction situations that are endowed with a sanctioning mechanism” (Voigt, 2013; pg. 5).

There are also those who find existing definitions inadequate and thus have attempted to provide unifying concepts of the term (Hindriks & Guala, 2015; Greif, 2006; Aoki, 2001). In one such ambitious attempt, Greif (2006), unifies two prevailing constructs. He combines the structural (or cultural) view of institutions as equilibrium phenomena that create a ‘structure’ for influencing behaviour with the agency or functionalist perspective that conceptualizes institutions as interactions among agents that delivers the ‘structure’. The structural and fundamentalist perspectives are actually reconcilable with the concept of de-jure and de-facto institutions. In effect, he describes institutions as, “the implication of manmade, nonphysical factors that generate regularities of behaviour while being exogenous to each individual whose behaviour is influenced, such as belief systems and internalized norms that generate regularities of behaviour” (Greif, 2006; pg. 23). Greif (2006) further argues that culture is the driving force and thus the mechanism for the persistence of institutions.

Using insights from game theory, Aoki (2001) defines institutions as a “self-sustaining system of shared beliefs about a salient way in which the game is repeatedly played” (Aoki, 2001; pg. 10). In other words, he presents institutions as an equilibrium outcome of a repeated game. To make this clearer, consider players in a game with an action profile (a set of feasible actions)

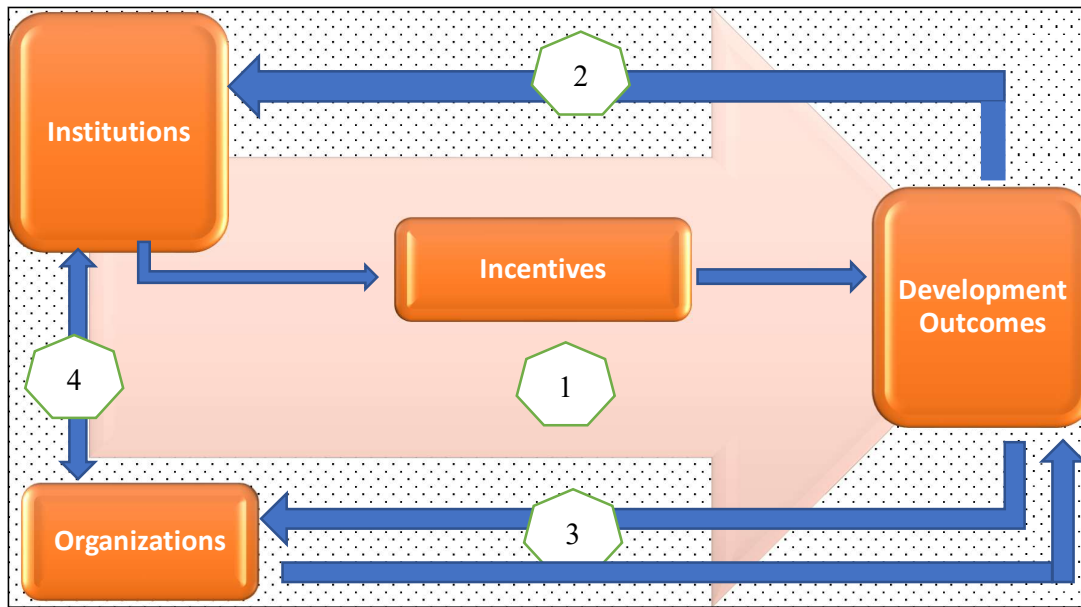
²⁵ Ostrom (1986; pg. 5) defines rules as “prescriptions commonly known and used by a set of participants to order repetitive, interdependent relationships”.

and expected payoffs. Consider a function (say an exogenous rule) that mediates between actions and payoffs. For any action, each player seeks to maximize their payoff. However, within the setting of a repeated game, each player considers the action of other players in deciding on a best choice. The action of a player, therefore, evolves in a process of attempting to understand the actions of other players. This continues until some stable (Nash) equilibrium is reached where each player has no incentive to deviate from an action, given that other players hold the same beliefs about agency. According to Aoki (2001), these “equilibrium beliefs” reflecting self-sustaining expectations about the action of players is what is referred to as institutions. They may or may not be formally codified as statutory laws, social structures, etc. He, however, argues that these constructs fail to qualify as institutions if they are not regarded by the agents in the economy or society.

In neoclassical theory, assumptions about consumer rationality in a perfectly competitive, frictionless market, displaces the need for institutions. In Coase’s rendering of this view, when markets are competitive and operate without cost, the allocation of resources is optimal (Coase, 1960). On the basis of this narrative, interactions between players in the market lead to an increase in aggregate income. The implicit assumption of the existence of complete information coupled with the notion of a zero cost of transactions in a society with complex interactions suggests the role of institutions to be redundant. This framing of the world has however been long challenged by both economists and non-economists (North, 1990; Wallis and North, 1986; Margolis, 1982). For instance, despite important extensions to the neoclassical utility-maximization models, they still are unable to explain nor adequately account for human behaviour that border on self-imposed restraints and altruism (North, 1990).

The power of institutions lies in the ability to determine incentives, which then impacts on development outcomes (Acemoglu & Robinson, 2008). This is the main thrust of the New Institutional School. The relationship between institutions and development can, however, assume a complex dimension beyond a unidirectional relationship. Figure 1.0 below attempts to capture the complex interactions between institutions and development outcomes. We use arrows numbered 1 through 4 to attempt to model this complex relationship. The central arrow (numbered 1), which happens to be the largest, captures the argument of the New Institutional School. The work of Acemoglu et al. (2001), among others, typifies this view. In essence, once one accounts for institutions, there is no statistically significant difference between incomes per capita in the tropics as compared to those of the west.

Figure 3: Link between institutions and development outcomes



Source: Author's construct, 2019

Arrows 2 through 4 four, however, emphasized the fact that the relationship between institutions and development is more than unidirectional. For instance, the transformative process of economic growth and development is usually characterized by technological advancement, productivity growth and economies of scale advantages. These changes, which may begin with specific sectors, have a way of shaping prevailing institutions. For instance, the technological revolution of the 1990s paved way for the reform of institutions given the evolution that has characterized market transactions, principally, reducing human contact. Furthermore, the fast-changing technological space through innovations, digitization and automation is pushing governments to consider laws and regulations that harnesses the full benefits while at the same time safeguarding shared social values including privacy and the sanctity of human life. The recent European Union Data Usage Policy instituted to protect the privacy of social media subscribers and other users of internet content is an example of how technological advancement contributes to shaping institutions.

In keeping with Aristotle's rule of thumb, definitions need not provide a complete description of an entity. Rather, it must signify its essence²⁶. Thus, we settle on North, who provides an eclectic frame for understanding the essence of institutions. North presents institutions as a composite concept with constituent parts. He distinguishes between formal and informal institutions while at the same time acknowledging their interactions. In his view, formal institutions are hierarchical, ranging from the role of constitutions to that of contracts. Furthermore, he distinguishes between political institutions, economic institutions and contracts. Thus, in his framing, contracts are subject to political and economic institutions. Informal institutions, on the other hand, would include taboos, customs, norms and conventions. North points out that institutions need not be efficient although they contribute to increasing efficiency whether in political or economic markets (North, 1990). He also acknowledges that the relationship between formal institutions and performance is not automatic as it is intermediated by informal rules.

In section 3.1.2 we explore the literature on the role of institutions in development. We then look at the empirics regarding the role of institutions in influencing the natural resource curse. Next, we review work on the mediating role of institutions in the relationship between natural resource dependence and non-resource tax effort. Section 3.2 discusses the theoretical framework followed by a presentation of the empirical framework in section 3.3. In section 3.4, we present and discuss the findings and the possible policy implications. We present a summary of this empirical chapter in section 3.5. We are guided by the theoretical distinction between different types of institutions as well as empirical advancement in the construction of data on institutions to disentangle how different types of institutions mediate the relationship between resource revenues and non-resource tax effort.

²⁶ Hodgson (2015) employs the Aristotelian framework to define institutions

3.1.2 The Role of Institutions in Development

One of the strong criticisms that early scholars of neoclassical economics received was a lack of formal treatment of the role of institutions. The concept was largely ignored or implicitly assumed in formal economic models (Arkadie, 1990). Institutions, however, shape the incentive structure of an economy (North, 1991). They determine the distribution of costs and benefits and thus influence the nature and outcome of interactions within any political, economic or social system. For instance, trading across Europe between the 8th and the 18th century was highly influenced by merchant guilds, a formal association of traders²⁷. These guilds provided an institutional framework for reducing transaction costs through managing risks and uncertainties (Grafe & Gelderblom, 2010; The World Bank, 2002). Similarly, the Maghribi were known merchants in North Africa, who set up trading posts across the Mediterranean. The trading posts were manned by their own agents. The social ties that existed between the merchants and the agents created a form of social capital that was necessary for trade. The ‘bond’ meant that there was free flow of information. These medieval merchants had unwritten self-enforcing codes of trade that provided a credible threat for those who attempted to cheat. The merchants did not have to travel with their goods. Cross-border trade flourished. These institutions were later to be replaced by local government councils.

Countries with institutions that effectively constrain the executive branch often tend to have better development outcomes²⁸. The Glorious Revolution in 1688 in England, which constrained the powers of the reigning monarch, is for instance linked to the famous industrial

²⁷ Before then, there were accounts which suggested that trade was on an individual basis (Grafe & Gelderblom, 2010).

²⁸ This view has not gone unchallenged. For instance, Glaeser, Porta, Lopez-De-Silanes, & Shleifer (2004) find human capital to be more important for growth than political institutions while Eregba & Mesagan (2016) suggest that within oil-rich contexts in Africa, the quality of institutions are unable to undo the resource curse.

revolution of that era (Acemoglu & Robinson, 2008). The primacy of institutions is argued in the literature (Rodrik, 2004). There are several other studies that suggest that the type of institutional arrangement in place explain development outcomes relating to investment, human capital development, financial development and economic growth (Miller, Toffolutti, & Reeves, 2018; Al Mamun, Sohag, & Hassan, 2017; Flachaire, García-Peñalosa, & Konte, 2014; Ang, 2013; Fosu, 2013; Fosu, 2008; Acemoglu & Johnson, 2005; Johnson, McMillan, & Woodruff, 2002; Hall & Jones, 1999).

Different political institutions, including those with different colonial traditions, deliver different development outcomes (Acemoglu, Naidu, Restrepo, & Robinson, 2018; La Porta, Lopez-de-Silanes, & Shleifer, 2008; Acemoglu, Johnson, & Robinson, 2001). According to Acemoglu et al. 2001, countries like the United States, Canada, Australia and New Zealand were established as settler colonies. Settler mortality rates were low in these regions as compared to the malaria-infested regions of West Africa, for example. The colonial governments, therefore, invested in building strong institutions in the settler colonies, which invariably created the incentives for the sustained growth and development that these countries now enjoy. Johnson et al. (2002) find that security of property rights creates incentives for local firms to invest while control of corruption reduces capital flight (Osei-Assibey et al., 2018). Firms are more likely to reinvest their profits in their business if they are able to keep the returns on their investment (i.e. no risk of expropriation). More recently, Acemoglu et al. (2018) find a large and statistically significant effect of democracy on per capita national income in the long-run. Other authors also find that the positive effect of changes in political institutions on

economic outcomes still holds true in politically unstable regions such as Africa, at both the macro and micro levels (Bates, Block, Fayad, & Hoeffler, 2012)²⁹.

A number of pioneering studies also examine the nature of judicial systems across countries, their origin and how these impact on economic outcomes such as GDP growth, economic freedom and financial development (La Porta, López-de-Silanes, Pop-Eleches, & Shleifer, 2004; Djankov, La Porta, Lopez-De-Silanes, & Shleifer, 2003; Glaeser & Shleifer, 2002; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1998; La Porta, Lopez-De-Silanes, Shleifer, & Vishny, 1997). La Porta et al. (1998, 1997) distinguishes between common law countries whose legal origin can be traced to the United Kingdom and civil law countries who belong to the French tradition. They find that countries with a common-law tradition do better at protecting investors than those with civil law origin. La Porta et al., 2008 provide a summary of the evidence in previous literature. In particular, La Porta et al. (2004) use data from 71 countries to explore the relationship between checks and balances provided by the judiciary and economic freedom (and political freedom) within a state³⁰. They find that the independence of the judiciary, as well as powers conferred on it to conduct constitutional review, have strong predictive influence on both economic and political freedoms. At the sub-national level, Brown, Cookson, & Heimer (2017) find that effective court systems are associated with high-income levels. At the micro-level, effectiveness in enforcement of contracts by courts is associated with increased relational contracting, where firms explore new clients and establish new relationships for business (Johnson, McMillan, & Woodruff, 2002b). In a meta-regression

³⁰ Economic freedom is measured by security of property rights, limited government regulation and modesty of state ownership while political freedom is measured by democracy, political and human rights.

analysis, Efendic et al., 2011 concludes that institutional quality exert a positive effect on economic outcomes

3.1.3 The Effect of Institutions in the Natural Resource Curse Hypothesis

Bhattacharyya & Hodler (2014) find that natural resource revenues undermine financial development in countries with weak political institutions. In an earlier paper, they found that the effect of natural resource rents on corruption is dependent on the quality of institutions (Bhattacharyya & Hodler, 2010). In effect, resource rents increase corruption when there are weak democratic institutions – a finding also confirmed by Neudorfer (2018). According to Collier & Hoeffler (2009), constraints on executive power, rather than electoral competition, is important for moderating the adverse effect of natural resource rents on economic growth. The moderating impact of institutions on the natural resource curse is confirmed by several other studies (Amiri, Samadian, Yahoo, & Jamali, 2018; Alsharif & Bhattacharyya, 2016; Arezki and Gylfason, 2013; Fosu, 2011; Mehlum, Moene, & Torvik, 2006). Andersen & Aslaksen (2008) make a distinction between presidential democracies and parliamentary democracies. Their findings suggest that parliamentary democracies have better economic growth outcomes in the presence of natural resources than presidential democracies. Szalai (2018) finds that natural resource abundance is a blessing when the quality of institutions is robust to ensuring transparency and accountability. Otherwise, natural resource revenues are associated with depressed economic growth when there is lack of transparency (see also Williams, 2011).

Other recent studies also suggest that if the quality of institutions are high enough, natural resource dependence actually confers positive outcomes through eliminating the Dutch disease, (Amiri et al., 2018), improving public investment (Karimu et al., 2017) and enhancing

economic growth (Sarmidi, Hook Law, & Jafari, 2014; Boschini et al., 2013a). Mehlum et al. (2006) finds that amidst poor institutions, natural resource endowments³¹ could undermine growth as resources are re-directed from “productive” activities into “unproductive” ones. Good institutions, however, play a mitigating role (Ushie, Adeniyi, & Akongwale, 2013; Kolstad, 2009). Resource rents have positive effects on non-resource national output and public investment when institutions, proxied by the Public Investment Management Index (PIMI), are good³² (Woldeyes, 2013). Countries that perform better on the PIMI do a better job of diversifying their economy away from the dominant resource sector.

3.1.4 The Role of Institutions in the Fiscal Resource Curse

The New Institutionalists view that political power can be exercised in a manner that inures to the benefit of society has some empirical basis (Acemoglu, Naidu, Restrepo, & Robinson, 2018; Bates, Block, Fayad, & Hoeffler, 2013; North, 1981). Laws can be passed, norms promoted and systems built to create an enabling environment for enterprise, growth, reduction in inequality and elimination of extreme poverty. In the same vein, fiscal policy could be informed by the promulgation of laws, including tax codes and Appropriation Acts, which are set in motion by state institutions charged with the mandate. As such, there is the view that the quality of fiscal policy-making process and the eventual outcome is mediated by the quality of institutions in place. For instance, some attribute deficient fiscal capacity to weak political institutions (Thies, 2010). Whereas different types of institutions be they political, social or economic, may impact differently on development outcomes and revenue performance, they could also be interactive in their workings (El Anshasy & Katsaiti, 2013).

³¹ We reckon the distinction between resource endowments (measured by proven reserves) and resource dependence (measured by production or exports) however we sometimes use them interchangeably except in cases where we find it important to make a clear distinction (see Boschini et al. 2013).

³² Article distinguishes between good and bad PIMI using a cut-off point. Countries such as Congo Republic, Togo, Senegal and Gabon with a score less than or equal to 1 are categorized as having bad PIMI.

Furthermore, there are those studies that link the types of political institution in place to the form of fiscal policy adopted (Knack, 2009; Hagen, 2003). The kind of incentives governments in democratic countries face in their bid to raise revenue for development does not necessarily match those in less democratic contexts. Citizens in a democracy are more likely to demand accountability as a right to lay claim to but also as a prerequisite to their commitment to pay taxes. Democracies are also more likely to offer space for the development of efficient tax systems as there would be pressure on elected officials to do so (Knack, 2009). While the pressure that democracies face does not automatically translate into a higher tax take, it does impact revenue outcomes³³.

The role of political cycles in mediating the relationship between resource revenues and non-resource taxes can be seen in how short-term election cycles undermine long term planning. Klomp & de Haan (2016) and McGuirk (2013) find that natural resource rents undermine fiscal capacity through its effects on tax collections prior to election. Governments use rents to reduce the tax burden and increase expenditure in lieu of attracting votes. Klomp & de Haan (2016) find this effect present in fledgeling democracies. We expect non-resource taxes to diminish in such instances. In addition, the challenge of information asymmetry –more pronounced in developing country contexts - constrains the ability to maximize revenue from the resource sector, where large multinational firms are involved. For instance, although the government of Ghana expected corporate tax payments from oil companies in 2011, following the start of the production of oil in commercial quantities, it was not until 2013 that they started paying corporate taxes (Roe, 2018). Furthermore, weak institutions undermine the possibility of

³³Consider an alternate situation where special interest groups and lobbyists within a democratic context are able to secure generous tax treatments (amnesties, exemptions, etc.)

directing resource rents towards efficient ends that potentially expands the economy and increases the non-resource tax base. In a study of 42 oil-producing countries, Koh (2017) finds that the quality of institutions mediates between the effect of sovereign wealth funds on the pro-cyclicality of fiscal policy. Using panel VAR, he finds that in countries with high quality institutions, oil funds mitigates the pro-cyclicality of government spending.

In a study of 98 countries over the period 1981 to 2011, Masi et al. (2018) examine the role of political institutions in mediating the relationship between natural resource rents and non-resource taxes (measured by non-resource taxes on income, profits and capital gains as a share of total non-resource taxes). They employ both cross-section and panel methods (fixed effect estimator), mostly preferring the latter for their global sample. They find that resource rents and non-resource taxes are negatively associated except when the level of constraints on the executive is high. In the case of the latter, the fiscal resource curse is neutralized and in some cases overturned. Botlhole et al. (2012) present similar findings for 45 Sub-Saharan African countries over the period 1990-2007. Using a Two-Stage Least Squares Instrumental Variable approach within a panel setting, they find that good quality institutions constrain the adverse effect of resource rents on non-resource tax effort. An institutional quality level slightly above the mean of their sample totality reverses the adverse effect of resource rents on non-resource tax effort. In a most recent evidence of the fiscal resource curse, Mawejje (2019) uses country membership of the Extractive Industries Transparency Initiative (EITI) as a measure of institutions. Using a sample of 31 Sub-Saharan African countries over the period between 2003 and 2015, the study uses fixed-effects and dynamic GMM estimators to report a negative relationship between resource revenues and tax revenues. While EITI membership has a moderating influence on the deleterious impact of resource revenues on tax revenues, the influence is weak and thus unable to neutralize the fiscal resource curse.

3.1.5 Contribution to the literature

Our study is distinguished from others in a number of ways. First, we use an extensive approach, which explores multiple measures of institutions and the extent to which they mediate the relationship between natural resource rents (revenues) and non-resource tax effort. To effectively evaluate this relationship, we also engage with different econometric techniques to satisfy robustness requirements. The work of Masi et al. (2018), is most closely related to the questions we seek to explore in this empirical chapter. Our work is however distinct in many regards when compared to theirs. A key innovation is that we develop a theoretical model that examines the interactions between institutions and resource rents in determining non-resource tax effort.

Next, we empirically examine its main predictions globally but also for ‘local contexts’ such as for Lower-income and Lower-Middle-Income Countries. These group of countries are most notable for their natural resource dependence. Our main dependent variable is non-resource tax revenues as a percentage of GDP. This measure differs from non-resource tax on income, profits and capital gains as a share of total non-resource tax revenues, which is used by Masi et al. (2018). It is also different from total tax revenues as used by Mawejje (2019). We choose non-resource tax as a percentage of GDP as our dependent variable in order to focus on the entirety of the sustainable part of the tax base (which would, therefore, exclude natural resource taxes). Our measure is also consistent with the standard definition of non-resource tax effort (see Bornhorst et al, 2009). However, unlike Borhorst et al (2009), our main explanatory variable is not restricted to hydrocarbon revenues or mineral revenues but rather a combination of the two (in addition to forest rents) since it is common to see resource-rich countries having a combination of these natural resources.

Finally, we find that the empirical literature generally adopts a homogeneous approach in looking at the role of institutions without adequately emphasizing the plausibility that different types of institutions could exert a differential impact on non-resource tax effort. We depart from this convention by undertaking an analysis that allows for examining the differential impact of different types of institutions on non-resource tax effort. We extend further the approach adopted by Collier and Goderis (2009), who distinguish between the effect of two types of institutions commonly used in the literature: constraints on executives and electoral competitiveness. By this approach, we are not only positioned to determine whether institutions matter but also if they do, which types are important to improving fiscal capacity.

3.2 Theoretical Framework

In this section, our goal is to develop a simple static model that predicts the role of institutions on non-resource tax effort in the presence of natural resources. We provide a proof of these predictions using optimization methods supported by a simple simulation exercise.

3.2.1 A Theory on Role of Institutions in Non-Resource Tax effort: Model Set-Up

The model set up comprises an open economy with two sectors: a natural resource sector made up of tradeable hydrocarbons and minerals (e.g. crude oil, natural gas, gold, diamonds etc.) and a non-resource sector made up of other goods and services. Products from the latter are outside the natural resource sector and therefore have a more diversified base. There exists a social planner who determines effort applied to mobilizing revenues from the two sectors. We define effort as the delivery of the relevant policy and administrative (including implementation) infrastructure to mobilize revenues. The social planner also determines the allocation of costs and benefits to two existing groups in the society: elites or incumbent and non-elites or the

opposition group. The allocation of costs and benefits is influenced by an exogenous constraining parameter which we define as a measure of institutions.

3.2.1.1 Model Propositions

Our model predicts the following:

1. Institutions have a weak moderating influence on the adverse effect of resource rents on non-resource tax effort.
2. Resource rents undermine non-resource tax effort when export prices of the commodities or the rents from them are sufficiently high. The moderating effect of institutions is muted in such an instance.

3.2.1.2 Proof of Propositions

We present definitions of the key variables in our model as follows:

e_r is revenue collection effort in the natural resource sector

e_{nr} is tax collection effort in non-resource sector

$T_r = pe_r$ is total revenue in resource sector and p is the export price index for natural resources

$T_{nr} = e_{nr}$ is tax revenue in non-resource sector³⁴

$c(e_r)$ is total cost of revenue collection effort in the resource sector

$d(e_{nr})$ is cost of tax collection effort in non-resource sector. The cost functions $c(.)$ and $d(.)$

are convex.

W is the social welfare function, which is continuously differentiable.

³⁴ As a benchmark, prices in the non-resource sector is normalized to 1

$V_1(g_1)$ represents benefits to group 1, the non-elites, when g_1 units of total revenue is allocated to them. Another way of viewing the non-elites would be the section of the population belonging to the opposition. The assumption here is that members of the population can belong to only one of two groups.

$V_2(g_2)$ is benefit to group 2, the elites or the incumbent group, when g_2 units of total revenue is allocated to them. The utility functions $V_1(\cdot)$ and $V_2(\cdot)$ are strictly concave.

$\alpha \in [0,1]$ is an exogenous parameter which refers to the weight of the non-elites in social welfare.

E is the aggregate effort for revenue mobilization. So that $E = e_r + e_{nr}$

Thus, the social planner chooses g_1, g_2, e_r and e_{nr} to maximize:

$$W = \alpha V_1(g_1) + (1 - \alpha) V_2(g_2) - c(e_r) - d(e_{nr}) \quad (1)$$

subject to: $E = e_r + e_{nr}$ and $g_1 + g_2 = T_r + T_{nr}$

Re-writing the constraints $e_r = E - e_{nr}$ and $g_2 = T_{nr} + T_r - g_1$ but also noting that $T_{nr} = e_{nr}$ and

$$T_r = p e_r$$

$$g_2 = pE - p e_{nr} + e_{nr} - g_1.$$

Put $g_2 = pE - p e_{nr} + e_{nr} - g_1$ and $e_r = E - e_{nr}$ into equation (1). So that:

$$W = \alpha V_1(g_1) + (1 - \alpha) V_2(pE - p e_{nr} + e_{nr} - g_1) - c(E - e_{nr}) - d(e_{nr})$$

The first order conditions (FOCs) are:

$$\frac{\partial W}{\partial g_1} = \alpha V_1'(g_1) - (1 - \alpha) V_2'(\cdot) = 0 \quad (2)$$

Where the V's are partial derivatives and $(.)$ is $pE - pe_{nr} + e_{nr} - g_1 = g_2$

The FOC in equation (2) suggests that at the optimum, the weighted marginal utilities (benefits) of both elites and non-elites must be equal.

$$\frac{\partial W}{\partial e_{nr}} = (1-p)(1-\alpha)V_2'(\cdot) + c'(E - e_{nr}) - d'(e_{nr}) = 0 \quad (3)$$

The FOC in equation (3) suggests that at the optimum, the weighted marginal benefit (utility) of the elite group must equal to the weighted marginal cost (the ratio of the cost differential between non-resource tax collection effort and resource revenue collection effort to their respective price differential). In other words, as the cost of tax collection effort in the resource sector goes up, export prices must go up by the same margin to maintain the same marginal utility for the elite group.

Second-order conditions (SOCs) for a maximum require that:

$$W_{11} \equiv \frac{\partial^2 W}{\partial g_1^2} < 0; \quad W_{22} \equiv \frac{\partial^2 W}{\partial e_{nr}^2} < 0 \quad \text{and} \quad W_{11}W_{22} - (W_{12})^2 > 0$$

Given our assumptions about the strict concavity of the utility functions, the SOCs hold. Thus, the Jacobian for the system of equations (2) and (3) is non-zero. By implicit function theorem, (2) and (3) give:

$$g_1^* = g_1^*(p, \alpha) \quad \text{and} \quad e_{nr}^* = e_{nr}^*(p, \alpha) \quad (4)$$

Put (4) into equations (2) and (3) and differentiate with respect to p

From (2)

$$\alpha V_1'(g_1^*(p, \alpha)) - (1-\alpha)V_2'(pE - p(e_{nr}^*(p, \alpha)) + e_{nr}^*(p, \alpha) - g_1^*(p, \alpha)) = 0$$

$$\text{where } g_2^* = pE - p(e_{nr}^*(p, \alpha)) + e_{nr}^*(p, \alpha) - g_1^*(p, \alpha)$$

Partially differentiating equation (2) with respect to p yields:

$$\alpha V_1''(g_1^*) \frac{\partial g_1^*}{\partial p} - (1-\alpha) V_2''(g_2^*) \left(E + (1-p) \frac{\partial e_{nr}^*}{\partial p} - e_{nr}^* - \frac{\partial g_1^*}{\partial p} \right) = 0$$

(5)

From (3)

$$(1-p)(1-\alpha) V_2' \left(pE - p e_{nr}^*(p, \alpha) + e_{nr}^*(p, \alpha) - g_1(p, \alpha) \right) + c'(E - e_{nr}^*(p, \alpha)) - d'(e_{nr}^*(p, \alpha)) = 0$$

Partially differentiating equation (3) with respect to p yields:

$$-(1-\alpha) V_2'(g_2^*) + (1-p)(1-\alpha) V_2''(g_2^*) \left(E + (1-p) \frac{\partial e_{nr}^*}{\partial p} - e_{nr}^* - \frac{\partial g_1^*}{\partial p} \right) - c''(E - e_{nr}^*) \frac{\partial e_{nr}^*}{\partial p} - d''(e_{nr}^*) \frac{\partial e_{nr}^*}{\partial p} = 0$$

(6)

From equations (5) and (6), we group like terms, rearrange, put in matrix form, and apply

Cramer's rule to get:

$$\frac{\partial e_{nr}}{\partial p} = \frac{\begin{vmatrix} A & B \\ C & D \end{vmatrix}}{J}; \text{ where } J \text{ is the Jacobian. It is positive from the second-order condition. So the}$$

sign of $\frac{\partial e_{nr}}{\partial p}$ depends on the sign of the numerator. If p increases, then there is an exogenous

increase in export prices and therefore resource rents. If resource rents have a negative effect

on non-resource tax effort, then we expect $\frac{\partial e_{nr}}{\partial p} < 0$ and vice versa. To verify, we rearrange

equations (5) and (6), group the like terms, put in matrix form and apply the Cramer's rule.

From (5)

$$\left(\alpha V_1''(g_1^*) + (1-\alpha) V_2''(g_2^*) \right) \frac{\partial g_1^*}{\partial p} - \left((1-\alpha)(1-p) V_2''(g_2^*) \right) \frac{\partial e_{nr}^*}{\partial p} = (1-\alpha)(E - e_{nr}^*) V_2''(g_2^*) \quad (7)$$

From (6)

$$-(1-p)(1-\alpha)V_2''(g_2^*)\frac{\partial g_1^*}{\partial p} + \left((1-p)^2(1-\alpha)V_2''(g_2^*) - c''(E - e_{nr}^*) - d''(e_{nr}^*)\right)\frac{\partial e_{nr}^*}{\partial p} =$$

$$(1-\alpha)V_2'(g_2^*) - (1-p)(1-\alpha)(E - e_{nr}^*)V_2''(g_2^*) \quad (8)$$

Let $a = (1-\alpha)$ and $b = (1-p)$

The matrix form of the system of equations (7) and (8) becomes

$$\begin{pmatrix} (1-a)V_1''(g_1^*) + aV_2''(g_2^*) & -abV_2''(g_2^*) \\ -abV_2''(g_2^*) & ab^2V_2''(g_2^*) - c''(E - e_{nr}^*) - d''(e_{nr}^*) \end{pmatrix} \begin{pmatrix} \frac{\partial g_1^*}{\partial p} \\ \frac{\partial e_{nr}^*}{\partial p} \end{pmatrix} = \begin{pmatrix} a(E - e_{nr}^*)V_2''(g_2^*) \\ aV_2'(g_2^*) + ab(E - e_{nr}^*)V_2''(g_2^*) \end{pmatrix} \quad (9)$$

Then

$$\frac{\partial e_{nr}^*}{\partial p} = \frac{\begin{pmatrix} (1-a)V_1''(g_1^*) + aV_2''(g_2^*) & a(E - e_{nr}^*)V_2''(g_2^*) \\ -abV_2''(g_2^*) & aV_2'(g_2^*) + ab(E - e_{nr}^*)V_2''(g_2^*) \end{pmatrix}}{J} \quad (10)$$

Since the sign of equation (10) depends on the sign of the numerator, we compute its determinant.

This gives:

$$\left((1-a)V_1''(g_1^*) + aV_2''(g_2^*)\right)\left(aV_2'(g_2^*) + ab(E - e_{nr}^*)V_2''(g_2^*)\right) + a^2b(E - e_{nr}^*)\left(V_2''(g_2^*)\right)^2$$

When we expand the terms in the bracket and restore our definitions of α and b , we have:

$$\alpha(1-\alpha)V_2'(g_2^*)V_1''(g_1^*) + \alpha(1-\alpha)(1-p)(E - e_{nr}^*)V_2''(g_2^*)V_1''(g_1^*) + (1-\alpha)^2V_2''(g_2^*)V_2'(g_2^*) +$$

$$2(1-\alpha)^2(1-p)(E - e_{nr}^*)\left(V_2''(g_2^*)\right)^2 \quad (11)$$

The sign of $\frac{\partial e_{nr}^*}{\partial p}$, which is our measure of the effect of resource rents on non-resource tax effort now depends on the values of α (the weight of non-elites in social welfare) and p (export prices), which is non-zero. In general, a higher value for α suggests that both non-elites and elites benefit from the distribution of the proverbial national cake. This is indicative of active institutions working for the good of all groups in the society. Stronger institutions imply that the ability of the elites to appropriate resources to themselves is weaker (see for example Bisin & Verdier, 2017 and Besley & Persson, 2011). While an increasing α is desirable, we do not expect its value to be close to 1 as this would imply that society is happy when the incumbent surrenders a greater share or all of the revenue benefits to non-elites. This is not only a case of extreme inequality but also one that it is unrealistic and counterintuitive. In the same vein, a value of α close to zero is suggestive of a society that does not care about the welfare of non-elites or those outside the incumbency. It connotes weak institutions. Thus, our best benchmark value for α is a value close to or equal to 0.5.

Recall that $T_r = pe_r$ and $T_{nr} = e_{nr}$. Thus, the marginal revenue benefits of resource tax effort and non-resource tax effort are respectively:

$$\frac{\partial T_r}{\partial e_r} = p \text{ and } \frac{\partial T_{nr}}{\partial e_{nr}} = 1$$

The above results suggest that for the export price $p > 1$, the marginal revenue benefit of resource tax effort is greater than the marginal revenue benefit of non-resource tax effort. The magnitude of marginal revenue benefits in the resource sector is therefore dependent on the magnitude of the prevailing export price. We interpret $p > 1$ as a sufficiently high export price. This situation could be proxied by a natural resource boom or sufficiently high levels of resource rents. An alternative scenario would be a value for $p \leq 1$, which suggests a low export

price level or a low level of resource rents. For instance, at the $p=1$, the marginal revenue benefit from resource tax effort is no different from that in the non-resource resource sector.

In the next section, we present a simulation exercise to detect the sign of the numerator of $\frac{\partial e_{nr}^*}{\partial p}$

for different possible levels of α and p .

3.2.1.3 Results and discussion of a simulation exercise

Having shown that the effect of resource rents on non-resource tax effort is dependent on the values of α and p , we proceed to perform a simulation exercise. Equation (11) has four terms as follows:

$$\begin{aligned} & \alpha(1-\alpha)V_2'(g_2^*)V_1''(g_1^*) + \alpha(1-\alpha)(1-p)(E-e_{nr}^*)V_2''(g_2^*)V_1''(g_1^*) + (1-\alpha)^2V_2''(g_2^*)V_2'(g_2^*) + \\ & \frac{2(1-\alpha)^2(1-p)(E-e_{nr}^*)}{1} \left(\frac{V_2''(g_2^*)}{2} \right)^2 \end{aligned}$$

4th term

We insert different values for α and p into equation 11 to ascertain the ultimate sign for

$\frac{\partial e_{nr}^*}{\partial p}$. Note that the marginal utility terms denoted by the first partial derivatives are positive

whiles the second partial derivatives are negative, denoting diminishing marginal utility. Table 17 evaluates the different values and signs. We provide possible interpretations of the results.

Table 17: Simulation exercise for values of α and p .

Values of α	Values of p	Sign of $\frac{\partial e_{nr}^*}{\partial p}$	Possible Interpretation
0	Less than 1	$\frac{\partial e_{nr}^*}{\partial p} > 0$	First scenario: In a situation where all benefits to revenue mobilization effort accrues to only the incumbent (an extreme scenario), a small increase in export prices would incentivize non-resource tax effort. First, all returns from this effort would only accrue to the elites. Another incentive to increase non-resource tax effort would be in the fact that rents from the resource sector are diminished in the face of lower export prices. The result suggests that non-resource tax effort may be positive even in the face of weak (redistributive) institutions.
0.5	Less than 1	$\frac{\partial e_{nr}^*}{\partial p} > 0$	Second scenario: Putting a constraint on the incumbent incentivizes non-resource tax effort in the face of a marginal increase in export prices. An alternative interpretation might be that when export prices are insufficiently high, a marginal increase in export prices sustains revenue effort in the non-resource sector. Total revenue base should then likely increase to benefit both groups.
0	Equal to 1	$\frac{\partial e_{nr}^*}{\partial p} < 0$	Third scenario: With a slightly higher export price relative to the first and second scenarios, a marginal increase in export prices diminishes non-resource tax effort.
0.5	Equal to 1	$\frac{\partial e_{nr}^*}{\partial p} < 0$	Fourth scenario: Similar to the third scenario, a slightly higher export price reduces non-resource tax effort for a marginal increase in export prices. Despite exerting a constraint on the social planner, the ultimate negative sign suggests that it does not avert the negative effect on non-resource tax effort when export prices increase marginally.
[0 0.5]	Greater than 1	$\frac{\partial e_{nr}^*}{\partial p} < 0$	Fifth scenario: Sufficiently high export prices undermine effort towards non-resource tax mobilization. A marginal increase in export prices in such a situation will lead to a reduction in non-resource tax effort. Like the fourth scenario, it is not evident that the role of institutions averts a diminished non-resource tax effort in the face of sufficiently high export prices or resource rents.

Source: Author, 2019

In summary, our results in Table 17 suggest that in most cases, a marginal increase in export prices undermines non-resource tax effort irrespective of the quality of (redistributive) institutions. The mitigating effect of institutional quality is especially weakened in the face of a natural resource boom. On the other hand, when export prices are insufficiently high and thus resource rents are low, a marginal increase in export prices can translate into a positive effect on non-resource tax effort. This positive effect is only achieved with better institutions. Generally, weak institutions characterized by the low survival rate of an incumbent government disincentivizes investment in fiscal capacity and encourage rent-seeking behaviour. In addition, weak institutions may increase the cost of investment in fiscal capacity. On the other hand, market-friendly institutions may contribute to increasing confidence in the economy, encouraging investment and expanding the tax base.

An important weakness of our model, however, is in the way we define and model the role of institutions. We restrict the definition to institutions that favour equity and redistribution without clarifying exactly on the type of institution. Secondly, there are different types of institutions, which may exert different impacts on non-resource tax effort in the face of different levels of export prices. We test for the key predictions of our model by accounting for the role of different types of institutions within an empirical framework. Note also that we do not formally model the effect of tax evasion and other fiscal malpractices. If tax evasion is equally likely in both sectors then the sign of $\frac{\partial e_{nr}^*}{\partial p}$ should not be affected. On the other hand, if there is tax evasion in say, the non-resource sector, the social planner would allocate less tax effort there (giving that the relative costs of effort there would be high). This should strengthen the result for $\frac{\partial e_{nr}^*}{\partial p}$, especially within the context of a weak institutional base for revenue mobilization.

3.3 Empirical Framework

We test a key insight from the predictions of the model within an empirical framework that proxies the effect of export prices and non-resource tax effort with total resource rents as a percentage of GDP and non-resource tax revenue as a percentage of GDP respectively. In essence, we explore the marginal effect of resource rents on non-resource tax effort within the context of different types of institutions.

3.3.1 Model Specification

We follow a base model specification similar to that specified in section 2.3.1 albeit with an interaction term as the main predictor variable. The main predictor variable is defined by different measures of institutions interacted with resource rents as a percentage of GDP. We specify a base econometric model as follows:

$$\left(\frac{R^{NR}}{Y}\right)_{it} = \beta_0 + \beta_1 \left(\frac{RRT}{Y}\right)_{it} + \beta_2 \left(\frac{RRT}{Y}\right)_{it} * INST_{it} + \beta_3 INST_{it} + \omega' (controls)_{it} + \varphi_i + \tau_t + u_{it}$$

(1)

The definitions for the various explanatory variables (including list of controls) remain as specified in section 2.3.1. We, however, introduce two new variables: $\left(\frac{RRT}{Y}\right)_{it}$ and $INST_{it}$.

$\left(\frac{RRT}{Y}\right)_{it}$ measures natural resource rents as a percentage of GDP for country i at time t .

$INST_{it}$ measures the quality of institutions in a country i at time t . β_2 is the interactive parameter of interest as it measures how institutions moderates the effect of resource rents on non-resource tax revenue. β_1 then captures the partial effect of resource rents on non-resource

tax effort. Thus from equation (1), the marginal effect of resource rents on non-resource tax effort is given by:

$$\partial \left(\frac{R^{NR}}{Y} \right)_{it} / \partial \left(\frac{RRT}{Y} \right)_{it} = \beta_1 + \beta_2 INST_{it} \quad (2)$$

This effect is not only dependent on the parameters β_1 and β_2 but also on the quality of institutions. We evaluate the marginal effect at the mean level but also by type of institutional measure.

As explored earlier, the literature provides different perspectives on understanding different types of institutions. For example, Aoki (2001) looks at institutions across four dimensions: political, social, economic and organizational while Greif (2006) distinguishes between structural and fundamental institutions. While these categorizations are most feasible in theoretical discussions, they become more complicated to deal with empirically. Available cross-country data on institutions do not always precisely fit into these distinctions (See Glaeser, Porta, Lopez-De-Silanes, & Shleifer, 2004 for an example of such critique). To circumvent this challenge, we take a practical approach by defining a set of measures of institutions among the most widely cited in the literature. Thus our main sources of data for these measures of institutions are the International Country Risk Guide (ICRG), Polity IV and the World Bank's Country Policy Institutional Assessment (CPIA). The details are provided in section 3.3.3. Given that we employ several measures of institutional variables, the number of econometric specifications and therefore tables generated are many.

3.3.2 Econometric Methods and Robustness Checks

We begin by estimating our base model by a Pooled Ordinary Least Squares method. We introduce our list of control variables, including country fixed-effects and time fixed-effects. Using both random-effects and fixed-effects estimators, we test for a contemporaneous interactive effect between quality of institutions and resource rents on non-resource tax effort. This first step is justified by the fact that except in rare cases such as during revolutions, changes in institutions are incremental and thus rarely discontinuous (North, 1990). We use a Hausman test to check for systematic differences between the random-effects and fixed-effects models if any.

We acknowledge that in general, it takes time for institutions to evolve. For instance, Savoia & Sen (2015) note that institutions are persistent and hence require a medium to long-term view when being analyzed. As such, we examine the interactive effect by transforming the data into five-year non-overlapping averages in a bid to assess the medium to the long-run effect of institutions³⁵. Although we employ both five-year and ten-year averages in order to capture slow changes and persistent nature of institutions, the five-year averages have an additional advantage of allowing for episodic variations in our institutional variables of interest in tandem with global political/electoral and business cycles across countries³⁶.

While the fixed-effects estimators deal significantly with endogeneity concerns across countries and over time, we see the need to account for the possibility of simultaneity bias. Countries with low levels of non-resource tax effort are more likely to depend on exploiting their natural resources or prone to corruption while lacking the ability to invest in building

³⁵ We also show results for transforming the data into ten-year non-overlapping averages. These are shown in the appendix

³⁶ McGuirk (2013) finds that on average, countries follow a 60 month (5-year) political cycle with a standard deviation of about 5 months.

strong institutions. To deal with this bias, we employ internal instruments for the endogenous variables (including interaction terms) using a generalized method of moments estimator. We test for the first and second-order of the autoregressive process. We also test for the exogeneity of instruments by evaluating the Hansen's test of overidentifying restrictions.

3.3.3 Data and Descriptive Statistics

In this section, we describe the key variables of interest as well as the source of the data. We also provide a table of summary statistics for these variables.

3.3.3.1 Resource rents as a percentage of GDP

The resource rents variable (*t_rent2gdp*) is obtained from the 2017 version of the World Bank's World Development Indicators Database. It combines available data on rents on oil, gas, coal, minerals and forests. By way of measure, rents represent the difference between the world (export) price of a commodity and its average cost of production, multiplied by the amount of production per period. Thus, total rents for each country over a period of a year are expressed as a percentage of the total Gross Domestic Product for that year.

3.3.3.2 Data on institutional variables: Polity IV Database

The Polity IV Database is a widely used database on political institutions developed through iterative improvements on earlier versions based on research and refinements in methodology. It codes characteristics of various states across the world, in the exercise of authority, spanning anything from autocratic tendencies to democracies. The first version, Polity 1 was launched in the mid-1970s. The latest Polity Project – Polity IV – has been in refinement since about the turn of the millennium³⁷. Among the several variables it contains, we make use of three key

³⁷ A new version, Polity V, is under development.

variables commonly adopted in the literature and designated as follows: polity2 score, democ and exconst.

Polity2 score

The polity2 score is a combined score comprising measures of democracy (democ) and autocracy (autoc). It measures the difference between the two variables on a 21-point scale ranging from -10 to 10. The score covers about 162 countries and spans the period 1980 to 2015. Autocracies may range in scores from -10 to -6, anocracies range from -5 to 5 and democracies score between 5 and 10. Details on the version of the data we use are contained in the 2016 Data Users' Manual (Marshall et al., 2016).

Democracy (democ_ed)

Democ_ed represents a measure of institutionalized democracy. It captures three key ingredients: the availability of institutions to guarantee citizens' right to choose their own leaders and express their policy preferences; the existence of institutions to constrain executive authority; and the right of citizens to enjoy civil liberties, especially political participation. The democ_ed variable encapsulates these elements on an 11-point scale ranging from 0 to 10.

Constraints on the Executive (exconst_ed)

The exconst_ed is a variable defined by the extent to which the decision-making authority of the executive branch of a state is constrained by other institutional structures within the state. Institutions that may impose such constraints include organized groups such as other branches of governments, political parties and other civil society organizations. The variable is measured on a 7-point scale ranging from 1 to 7. A lower score suggests unlimited authority exercised

by the executive while a higher score suggests greater constraints on the executive. The `exconst_ed` variable is a key constituent of the `democ_ed` variable.

3.3.3.3. Database on Political Institutions (DPI 2015)

Similar to the Polity IV database, DPI covers more than 100 variables that measure the quality of political institutions and electoral politics across about 180 countries. The database was first compiled by the Development Research Group of the World Bank in the year 2000. Currently, the database is being hosted by the Inter-American Development Bank. We employ three of the most widely used variables: checks, Legislative Index of Electoral Competitiveness (`liec`), and Executive Index of Electoral Competitiveness (`eiec`) in the January 2016 version of the database (Cruz, Keefer, & Scartascini, 2016). The data used in our empirical analysis cover the period from 1980 to 2015.

Legislative Index of Electoral Competitiveness (liec)

Given the importance of the legislative chamber in exercising checks over the executive, the index measures the extent to which the legislature is competitively composed. The measure looks at the extent of multi-party participation in legislative elections as well as in the composition of the assembly. The scoring is a 7-point scale with the minimum being 1 and the maximum is 7. The higher the score, the greater the participation of multiple parties and the lesser is the tendency of one party to control the whole legislative assembly.

Executive Index of Electoral Competitiveness (eiec)

The “`eiec`” employs a similar scale as the “`liec`”. It measures the extent to which the ruling executive is elected directly by the citizens or through an electoral college that is elected by the

citizens. Thus, countries that have these characteristics score highly while those with unelected representatives score values closer to 1.

Checks and Balance (checks)

The “checks” variable combines both “liec” and “eiec” to assess the level of checks and balances associated with an elected government. It is an 18-point scale ranging from 1 to 18. The score increases with higher scores in liec, in particular, greater control of the legislature by an opposition party. In parliamentary systems, the checks score increases with multiple parties in a government coalition with some constituent members having views closer to the largest opposition parties.

3.3.3.4 International Country Risk Guide (ICRG) database

The ICRG database provides ratings for political, financial and economic risk assessment for about 140 countries globally. It began in 1980 with the development of an ICRG forecasting model, which was then hosted by International Reports, a well-known weekly newsletter. By 1992, the PRS Group took over management of the ICRG model, further expanding its scope and coverage to what has now become widely known as the ICRG database. Each of the three components of the database has sub-components which add up to a total score of 100. Following the literature on the role of institutions in development, we take advantage of four sub-components under the political risk component, which are commonly used in the literature. These include law and order, socioeconomic conditions, investor profile and bureaucratic quality. The data used in the empirical analysis covers the period starting from 1984 to 2015.

Law and Order (laworder)

The variable has two parts: law and order. Each part carries a maximum score of 3 and a minimum score of 0. This brings the total score to 6. The ‘law’ part assesses how impartial the legal system of a country is while the ‘order’ part evaluates the extent to which the laws of the country are obeyed. The latter also assesses the extent to which sanctions are applied to the errant. The higher the score the greater the degree of commitment to law and order in any country year.

Investment Profile (investprof)

The investment profile variable captures risk to foreign investment in a country. It comprises three sub-components measuring risk of expropriation, profit repatriation and payment delays. Each sub-component carries a minimum score of 0 and a maximum score of 4. Total score sums up to 12. The higher the score, the lower the risks.

Bureaucratic Quality (bureacr)

The variable measures the extent to which a political system can withstand shocks associated with changes in government. It evaluates the potential for continuity in policy regardless of election cycles. It assesses the effectiveness of the bureaucracy in place. The maximum score is 4 while the minimum score is 0. The higher the score, the better the quality of bureaucracy in place.

Socioeconomic Conditions (socioecon)

The variable is made up of three sub-components that describe a country’s risk or exposure to societal pressure emanating from levels of unemployment, poverty and consumer confidence. They represent factors that fuel social dissatisfaction (Political Risk Services, 2015). Each of the sub-components carries a maximum score of 4 and a minimum score of 0. Thus the

composite score is 12. Higher scores signify lower risks to these societal pressures while lower scores depict otherwise.

3.3.3.5 Country Policy Institutional Assessment (CPIA) database

The CPIA database is a product of the World Bank Group. It is an annual assessment of the quality of policies and institutional performance in over ninety countries across the world. There are four key components driving the total CPIA score for a country: economic management, structural policies, policies for social inclusion/equity and public sector management and institutions. The variables we used derive from the latter component. We select two out of the five sub-components (property rights and rule-based governance and efficiency of revenue mobilization) given their relevance for revenue performance. The data as used in our empirical analysis covers the period from 2005 to 2015.

Efficiency of Revenue Mobilization (cpia_erm)

The variable provides an overall assessment of the policy and administrative environment for revenue mobilization. The existing tax structure, as well as processes to mobilize taxes from all possible sources, are evaluated from a minimum score of 1 to a maximum score of 6. The higher the score the more efficient a country's institutions are for revenue mobilization.

Property Rights and Rule-based Governance (cpia_prop)

The variable comprises three dimensions: existence of legal basis for the security of property and protection of contract rights; predictability, transparency, impartiality and enforcement of laws and regulations affecting economic activity; and the extent of control of crime and violence. The scores range from a minimum of 1 to a maximum of 6. The higher the score, the better the protection of property rights and exercise of rule-based governance.

3.3.3.6 Descriptive Statistics

We present in Table 18, a summary of key statistics for the key variables used in the empirical exercise. The first column shows the variable code. Columns 2 and 3 show the number of observations and mean value of a variable respectively. In columns 4 through 6, the table depicts the standard deviation, minimum and maximum values of the variables. There are two variable codes: democ (measuring democracy score) and exconst (measuring constraint on the executive branch of government), which contain special values³⁸: -66, -77 and -88. These values usually represent transition periods in the evolution of political institutions amongst states. We follow Marshall et al., (2016) in ‘fixing’ these values. Whenever an observation in the democ or exconst variable is scored -66, we convert the value to missing. When the value is -77, we convert to zero. Finally, when a score for democ or exconst is -88, we convert it to zero³⁹. The newly generated variable maintains its old name with the suffix ‘_ed’ attached. We make use of the new variable.

Table 18: Summary Statistics: Role of Institutions

	(2)	(3)	(4)	(5)	(6)
Variable	count	mean	sd	min	max
tot_nrestax	1978	14.922	6.890	0.6	37.577
t_rent2gdp	1978	8.146	10.789	0	63.521
grants	1978	1.137	2.099	0	24.713
Corrupt control	1978	2.753	1.193	0	6
agricval2GDP	1978	16.000	14.001	0.035	79.042
Log GDP per capita	1978	8.116	1.473	5.122	11.618
trade2GDP2	1978	89.221	64.210	0.274	455.415
socioecon	1978	5.377	2.238	0.5	11
laworder	1978	3.500	1.320	0	6
investprof	1978	7.599	2.293	0	12
Corrupt control	1978	2.753	1.193	0	6

³⁸ -66 represents foreign interruptions, -77 represent cases of anarchy while -88 represents other forms of transition following an independence, foreign interruption or anarchy.

³⁹ The conversion to zero then reflects the status of the state as a state-in-transition or an anocracy.

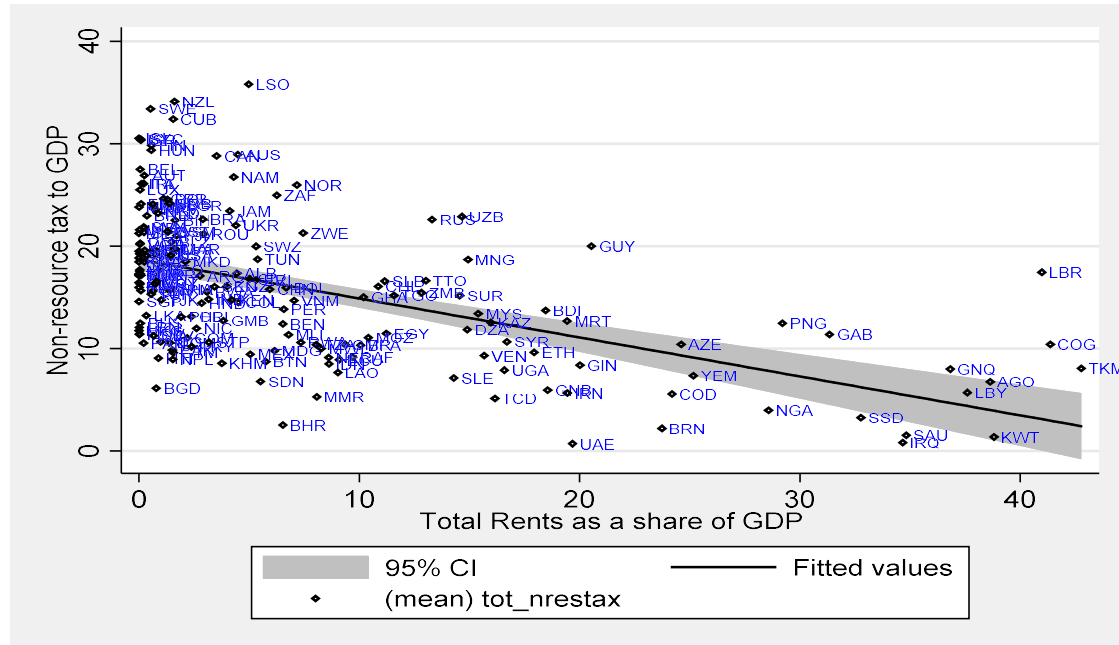
bureacr	1978	2.036	1.038	0	4
exconst	1826	2.607	13.659	-88.00	7
exconst_ed	1815	4.695	2.093	0	7
polity2	1814	3.298	6.124	-10	10
liec	1946	6.244	1.584	1	7
eiec	1946	5.939	1.833	1	7
checks	1925	2.814	1.728	1	18
lnapi	1805	3.911	2.169	-24.614	5.855
lnpop	1978	16.015	1.680	12.366	21.034
democ	1826	3.045	14.082	-88.000	10
democ_ed	1815	5.137	3.788	0	10
cpia_prop	328	2.864	0.558	1	3.5
cpia_erm	328	3.477	0.437	2.5	4.5
<i>N</i>	1978				

We include an additional list of covariates: log of consumer price index and log of population to facilitate robustness checks.

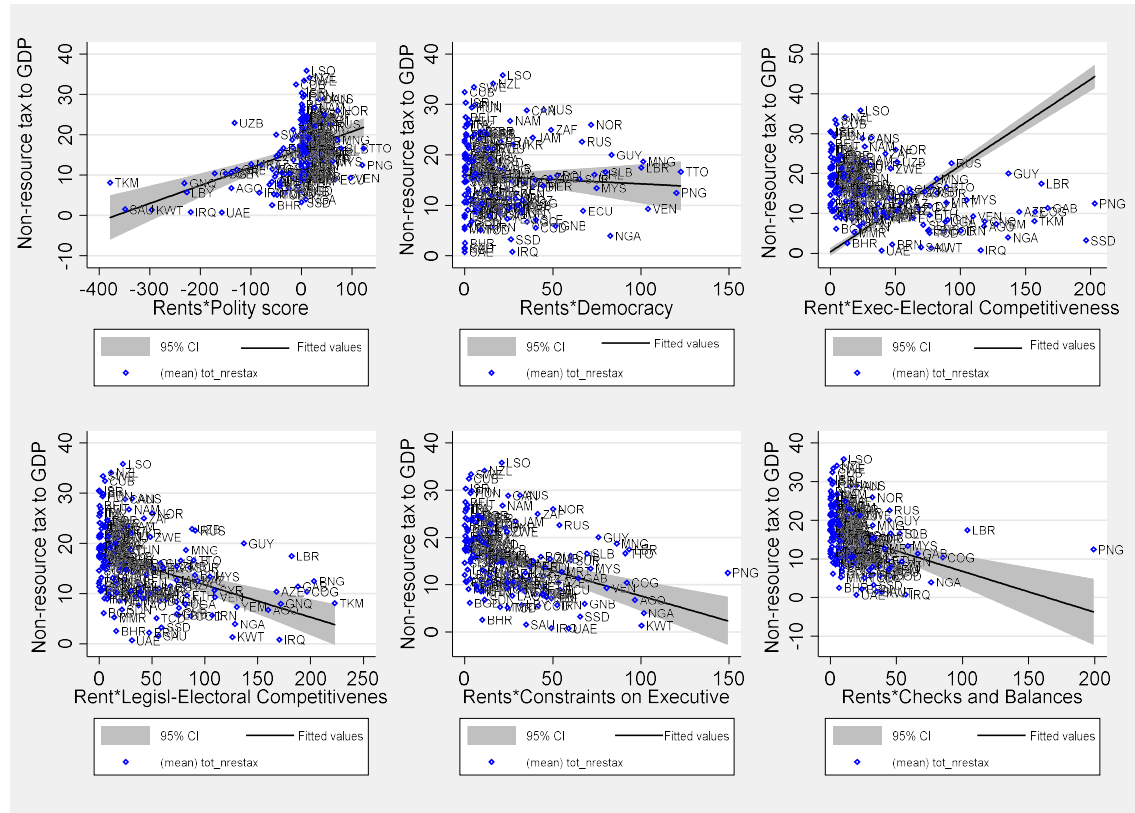
3.4 Empirical Results and Discussion

We explore the data using correlation analysis of our key variables of interest. First, we examine the correlation between resource rents as a percentage of GDP and non-resource tax effort as a percentage of GDP. We build on this by interacting the resource rents variable with our set of institutional variables. This allows for looking at correlations between the interacted variables and non-resource tax effort.

In Figure 4, we see a negative relationship between resource rents as a percentage of GDP and non-resource tax effort. The higher the level of rents, the lower the non-resource tax effort. Not surprisingly, we see the oil-rich states of Kuwait, Saudi Arabia and Libya, among others on the extreme right, while the extreme left is dominated by developed countries such as Belgium, Switzerland, Luxembourg and the likes.

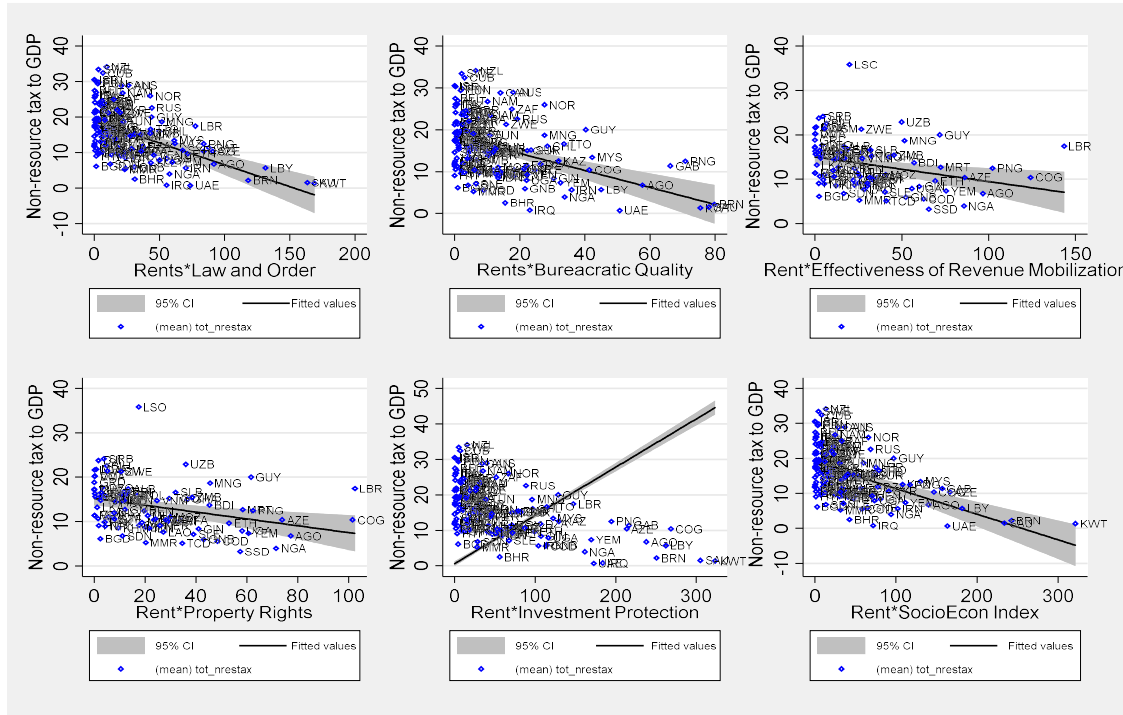
Figure 4: Relationship between total rents and non-resource tax effort

In Figure 5, we interact the resource rents variable with six measures of institutions: polity2 score, democracy, executive index of electoral competitiveness, legislative index of electoral competitiveness, constraints on the executive and checks and balances. We find that in half of the cases, the interactive effect is negative. It is however highly positive for the polity 2 score and executive index of electoral competitiveness.

Figure 5: Type of institutions, resource rents and non-resource tax effort

Source: Author-generated, 2019

In Figure 6, the interactive effect is examined for another set of six measures of institutions: law and order, bureaucratic quality, effectiveness of revenue mobilization, property rights and rule-based governance, investment profile and socioeconomic conditions. The interactive effect is only positive for the measure of investment profile. Overall, the correlation results seem to support the theoretical result about the importance of rents (relative to the moderating effect of institutions) in determining non-resource tax effort. These correlation results are however not robust to understanding our key research questions. For instance, they do not deal with omitted variable bias, endogeneity concerns and other econometric problems. We account for these in the subsequent sections.

Figure 6: Types of institutions, resource rents and non-resource tax effort (II)

Source: Author-generated, 2019

3.4.1 Panel OLS and Fixed Effect Estimators: Examining the Contemporaneous Effect

In Table 19, we examine a contemporaneous relationship between our variables of interest. We interact resource rents as a percentage of GDP with polity2 score, controlling for key covariates as suggested by the literature. The first two columns present OLS results followed by results from Random-effects Estimators in columns 3 and 4. In column 5, we display results from a Fixed-effects Estimator. We employ a Hausman test to determine whether a systematic difference exists between the Random-effects Estimator and the Fixed-effects Estimator. The null hypothesis of no systematic difference in coefficients yields a Chi-squared value of 10.31 with a p-value greater than 0.1. The p-value suggests that we fail to reject the null hypothesis.

Consequently, there is no sufficient evidence to conclude that coefficients of the Random-effects Estimator are systematically different from coefficients of the Fixed-effects Estimator.

We, therefore, opt for the former.

In columns 1, 2 and 3, the interaction effect is positive, suggesting a moderating role for political institutions on the adverse effect of resource rents on non-resource tax effort. However, this result is not robust to controlling for country invariant, time-varying unobserved factors such as global shocks. We account for the latter by including year dummies in columns 2, 4 and 5. Our joint test for the inclusion of time dummies rejects the null hypothesis of no time effects hence the inclusion of time effects is justified.

Table 19: Interactive Effect with Polity2: Global Sample

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) OLS	(2) OLS	(3) REE	(4) REE	(5) FEE
t_rent2gdp	-0.125*** (0.0114)	-0.133*** (0.0116)	-0.0545* (0.0315)	-0.0777** (0.0309)	-0.0579* (0.0337)
polity2	0.157*** (0.0305)	0.133*** (0.0309)	-0.0380 (0.0553)	-0.0375 (0.0561)	-0.0515 (0.0583)
c.t_rent2gdp#c.polity2	0.00637*** (0.00227)	0.00476** (0.00229)	0.00622** (0.00309)	0.00423 (0.00301)	0.00385 (0.00318)
grants	0.0352 (0.0568)	-0.0582 (0.0572)	0.0539 (0.0842)	0.0370 (0.0843)	0.0439 (0.0852)
Corrupt control	1.108*** (0.142)	1.624*** (0.165)	0.174 (0.245)	0.372 (0.288)	0.327 (0.296)
agricval2GDP	-0.00888 (0.0144)	7.36e-05 (0.0143)	-0.0676** (0.0328)	-0.0620* (0.0342)	-0.0690* (0.0370)
Log GDP per capita	1.303*** (0.180)	1.033*** (0.186)	2.544*** (0.617)	1.719*** (0.558)	1.919** (0.965)
trade2GDP2	0.00405 (0.00285)	0.00247 (0.00290)	0.00573 (0.00668)	0.00277 (0.00672)	0.00271 (0.00697)
Country effect	No	No	Yes	Yes	Yes
Time Effect	No	Yes	No	Yes	Yes
Observations	1,814	1,814	1,814	1,814	1,814
R-squared	0.412	0.438			0.164
Number of id	92	92	92	92	92

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Our specification of preference in column 4 suggests that the mediating influence of political institutions (measured by polity2 score) is not statistically significantly different from zero. Other factors such as the size of the informal economy (using agricultural sector value-added as a percentage of GDP as a proxy) and the size of the economy appear to be more important in increasing non-resource taxes as a percentage of GDP. A percentage point increase in agriculture's share of GDP reduces non-resource tax effort by 0.06 percentage points. On the other hand, a percentage point increase in GDP per capita is associated with a 0.02 percentage point increase in non-resource tax effort. To further examine the contemporaneous effect for other types of institutions, we employ the specification in column 4.

Table 20: Interactive Effect with Other Political Institutional Variables: Global Sample

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.113*** (0.0302)	-0.0858** (0.0337)	-0.0829** (0.0348)	-0.131*** (0.0306)	-0.106*** (0.0317)
eiec	-0.0881 (0.132)				
c.t_rent2gdp#c.eiec	0.00668 (0.00653)				
liec		-0.0226 (0.178)			
c.t_rent2gdp#c.liec		0.00117 (0.00593)			
checks			-0.161 (0.101)		
c.t_rent2gdp#c.checks			0.00119 (0.00954)		
exconst				0.0253 (0.147)	
c.t_rent2gdp#c.exconst_ed				0.0171*** (0.00571)	
democ_ed					-0.0672 (0.0907)
c.t_rent2gdp#c.democ_ed					0.0100** (0.00448)
grants	0.0336 (0.0787)	0.0322 (0.0815)	0.0361 (0.0792)	0.00746 (0.0809)	0.0302 (0.0842)
Corrupt control	0.435* (0.243)	0.437* (0.242)	0.427* (0.235)	0.344 (0.290)	0.354 (0.289)

agricval2GDP	-0.0572*	-0.0620*	-0.0724**	-0.0488	-0.0576*
	(0.0317)	(0.0350)	(0.0315)	(0.0319)	(0.0329)
Log GDP per capita	1.690***	1.610***	1.557***	1.742***	1.737***
	(0.545)	(0.539)	(0.553)	(0.547)	(0.552)
trade2GDP2	0.00592	0.00656	0.00727	0.00155	0.00264
	(0.00699)	(0.00702)	(0.00696)	(0.00638)	(0.00656)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	1,946	1,946	1,925	1,815	1,815
Number of id	96	96	96	92	92

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Tables 20 and 21 depict results based on the specification in column 4 of Table 19. In Table 20, we find the interactive effect to be positive for the variables on democracy and constraints on the executive. This suggests that the quality of democracy and the level of constraints on the executive has a mitigating influence on the adverse effect of resource rents on non-resource tax effort. The results suggest that in countries where citizens have the freedom not only to voice their policy preferences but also participate in decision making, they are able to better hold their governments to account on natural resource governance. For instance, natural resource exploration and production revolve around legal instruments which are debated crafted, debated and approved in national legislative assemblies. An active legislature, with support of active civil society groups, can mitigate the adverse incentives triggered by natural resource exploitation among ruling elites. The effects are statistically significant at conventional levels but small in magnitude. The results are also consistent with Masi et. al. (2018), who find a positive and statistically significant coefficient on their interaction term between total resource rents and executive constraints. Their measure of fiscal capacity, the outcome variable of interest, is however slightly different from ours. In Table 20, the coefficient of GDP per capita remains positive and statistically significant across all specifications. On average, the larger the overall tax base, the larger the non-resource tax potential of a country. On the other hand, the negative and statistically significant coefficient

on agriculture value-added as a percentage of GDP shows that countries with a larger agricultural sector have a challenged fiscal capacity. Control of corruption also appears to be important in improving non-resource tax outcomes as the variable turns statistically significant in columns 1 through 3.

None of the interactive effects turns statistically significant in Table 21. The coefficient on agriculture value-added as a percentage of GDP remains negative across all specifications except column four. The coefficient on GDP per capita is positive for all specifications except in columns four and five, which also happen to be the only specifications where the coefficient on trade openness is positive and statistically significant.

3.4.1.1 Estimating the marginal effects

On the basis of the institutional variables that turn statistically significant in our most preferred model specification, we estimate their marginal effects at the mean. For the `exconst_ed` variable, the marginal effect of resource rents on non-resource tax effort at the mean level of institutional quality is given by

$$\partial \left(\frac{R^{NR}}{Y} \right)_{it} / \partial \left(\frac{RRT}{Y} \right)_{it} = \beta_1 + \beta_2 INST_{it} = -0.13 + (0.017) * (4.7) = -0.05 \quad (1)$$

This suggests that constraints on the executive only reduce the adverse effect of resource rents on non-resource tax effort. The negative relationship is however sustained and is not overturned even if a country moves from the lowest level of institutional quality measured by `exconst_ed` to the highest possible value of seven. See computation of the turning point below:

$$\partial \left(\frac{R^{NR}}{Y} \right)_{it} / \partial \left(\frac{RRT}{Y} \right)_{it} = \beta_1 + \beta_2 INST_{it} = 0 \quad (2)$$

$$\text{Where } -0.13 + 0.017(INST_{it}^*) = 0 \quad (3)$$

Therefore, at the turning point $INST_{it}^* = 0.13 / 0.017 = 7.65$

The marginal effect for executive constraints is not qualitatively different from that of the democracy variable (-0.06). This is not surprising given the fact that the exconst variable is a key constituent of the democracy index. The Pearson's correlation coefficient between the two variables is 0.95.

Table 21: Interactive Effect with Measures of Effectiveness of Government: Global Sample

VARIABLES	Dependent Variable: Non-resource tax revenue as a percentage of GDP					
	(1)	(2)	(3)	(4)	(5)	(6)
	REE	REE	REE	REE	REE	REE
t_rent2gdp	-0.0545 (0.0390)	-0.0782 (0.0531)	-0.0975* (0.0528)	-0.360 (0.280)	-0.470 (0.379)	-0.00420 (0.0617)
bureacr	-0.0310 (0.386)					
c.t_rent2gdp#c.bureacr	-0.0207 (0.0227)					
investprof		-0.114 (0.135)				
c.t_rent2gdp#c.investprof		-0.000517 (0.00769)				
socioecon			-0.0664 (0.128)			
c.t_rent2gdp#c.socioecon			0.00395 (0.00903)			
cpia_erm				0.773 (1.083)		
c.t_rent2gdp#c.cpia_erm				0.0763 (0.0958)		
cpia_prop					-0.0434 (0.927)	
c.t_rent2gdp#c.cpia_prop					0.138 (0.128)	
laworder						0.428 (0.283)
c.t_rent2gdp#c.laworder						-0.0248 (0.0170)

grants	0.0289 (0.0804)	0.0359 (0.0800)	0.0299 (0.0807)	0.0769* (0.0455)	0.0668 (0.0436)	0.0477 (0.0753)
Corrupt control	0.449* (0.238)	0.469** (0.234)	0.441* (0.233)	1.201 (0.944)	1.095 (0.798)	0.251 (0.214)
agricval2GDP	-0.0631* (0.0354)	-0.0608* (0.0356)	-0.0605* (0.0358)	-0.178* (0.0984)	-0.185* (0.0959)	-0.0621* (0.0347)
Log GDP per capita	1.696*** (0.559)	1.733*** (0.526)	1.583*** (0.509)	-0.537 (1.240)	-0.733 (1.398)	1.907*** (0.545)
trade2GDP2	0.00515 (0.00638)	0.00589 (0.00655)	0.00610 (0.00636)	0.0489*** (0.0144)	0.0494*** (0.0163)	0.00610 (0.00632)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,978	1,978	328	328	328	1,978
Number of id	98	98	40	40	40	98

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Thus, in the short-run (within a year), the quality of democracy or constraints on the executive have a mitigating impact on the adverse effect of resource rents on non-resource tax effort. However, the quality of these institutions is unable to undo the fiscal resource curse. The marginal effects suggest that the institutional impact is weak relative to the incentives provided by an increase in resource rents. Von Haldenwang & Ivanyna (2018) also observe that political institutions (regime-type) seem not to matter in averting the adverse effects of shocks from resource rents on domestic revenues. This is also similar to findings that the quality of institutions is unable to overturn the resource curse in countries that are resource-rich (Eregha & Mesagan, 2016). Mawejje (2019)'s result on the weak moderating impact of institutional quality on the effect of resource rents on non-resource revenues further corroborates our findings although his definition of institutions is limited to the membership of the EITI.

Our results, however, show that other factors such as the size of the informal economy, size of the economy as a whole, controlling corruption and, to some extent, the volume of trade could be important in improving non-resource tax effort. The negative relationship between agriculture's share of GDP and tax revenues is also confirmed in studies by Von Haldenwang & Ivanyna (2018) and Ndikumana & Abderrahim (2010). Countries with a large agricultural sector relative to national output tend to have a highly informal economy where fiscal capacity is greatly handicapped. The evidence of a positive association between the tax base (measured by GDP per capita) and non-resource tax effort but also between the volume of trade and non-resource tax effort is demonstrated in Mawejje (2019), Bornhorst et al. (2009) and Gupta (2007). Our finding further agrees with Baum, Gupta, Kimani, & Tapsoba (2017) that control of corruption is positively associated with non-resource tax effort. Again, Gupta (2007) finds that improvement in trade is positively associated with non-resource tax effort.

The difficulties associated with raising taxes from the non-resource sector, especially developing countries, are well documented. In the case of developing countries, it is even more challenging. We re-examine this evidence in Tables 22 and 23 by evaluating the same set of specifications for developing countries. This approach enables us to assess the sensitivity of our results to our defined local context. The latter comprises of Low-income countries (LICs) and Lower-middle-income countries (LMICs) based on the World Bank Group's income classifications for countries.

Table 22: Interaction between institutions and resource rents: Short-run Effects for LICs and LMICS⁴⁰

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.0818** (0.0351)	-0.0851*** (0.0243)	-0.0631** (0.0290)	-0.0722** (0.0321)	-0.113*** (0.0375)
polity2	-0.0112 (0.0565)				
c.t_rent2gdp#c.polity2	0.00437 (0.00356)				
eiec		0.128 (0.140)			
c.t_rent2gdp#c.eiec		-0.000749 (0.00756)			
liec			0.236 (0.166)		
c.t_rent2gdp#c.liec			-0.00450 (0.00775)		
checks				-0.0612 (0.115)	
c.t_rent2gdp#c.checks				-0.00450 (0.0103)	
exconst_ed					0.202 (0.199)
c.t_rent2gdp#c.exconst_ed					0.0131* (0.00725)
grants	0.190** (0.0827)	0.189** (0.0817)	0.180** (0.0817)	0.193** (0.0792)	0.148** (0.0751)
Corrupt control	0.171 (0.405)	0.217 (0.401)	0.244 (0.406)	0.217 (0.406)	0.168 (0.401)
agricval2GDP	-0.0363 (0.0305)	-0.0361 (0.0279)	-0.0426 (0.0289)	-0.0481* (0.0288)	-0.0237 (0.0310)
Log GDP per capita	2.765*** (0.756)	2.350*** (0.664)	2.301*** (0.650)	2.577*** (0.718)	2.815*** (0.733)
trade2GDP2	0.0273*** (0.00935)	0.0302*** (0.00986)	0.0300*** (0.00909)	0.0284*** (0.00934)	0.0243*** (0.00894)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	916	915	915	915	917
Number of id	45	45	45	45	45

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

⁴⁰ Interaction term involving democ_ed also turns statistically significant at the 10 percent level with a coefficient of 0.00996 and robust error of 0.00515.

Table 23: Interaction between institutions and resource rents: Short-run Effects for LICs and LMICS (II)

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE	(6) REE
t_rent2gdp	-0.0899* (0.0508)	-0.0625 (0.0644)	-0.170*** (0.0547)	-0.403 (0.304)	-0.467 (0.383)	-0.0747 (0.0640)
bureacr	-0.0833 (0.454)					
c.t_rent2gdp#c.bureacr	0.00986 (0.0332)					
investprof		0.0897 (0.206)				
c.t_rent2gdp#c.investprof		-0.00300 (0.0119)				
socioecon			-0.0164 (0.206)			
c.t_rent2gdp#c.socioecon			0.0297** (0.0127)			
cpia_erm				0.875 (1.221)		
c.t_rent2gdp#c.cpia_erm				0.0913 (0.107)		
cpia_prop					0.00893 (1.003)	
c.t_rent2gdp#c.cpia_prop					0.140 (0.132)	
laworder						-0.0866 (0.258)
c.t_rent2gdp#c.laworder						-0.00103 (0.0193)
grants	0.189** (0.0792)	0.185** (0.0753)	0.179** (0.0797)	0.0843* (0.0482)	0.0673 (0.0446)	0.186** (0.0753)
Corrupt control	0.215 (0.398)	0.182 (0.380)	0.237 (0.412)	1.085 (0.921)	1.074 (0.811)	0.146 (0.388)
agricval2GDP	-0.0411 (0.0331)	-0.0422 (0.0300)	-0.0469 (0.0304)	-0.169* (0.0895)	-0.186** (0.0947)	-0.0431 (0.0308)
Log GDP per capita	2.635*** (0.808)	2.509*** (0.709)	1.868*** (0.690)	-1.175 (1.379)	-1.379 (1.480)	3.266*** (0.703)

trade2GDP2	0.0274*** (0.00910)	0.0276*** (0.00857)	0.0251*** (0.00898)	0.0509*** (0.0144)	0.0498*** (0.0163)	0.0286*** (0.00899)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	917	917	917	315	315	917
Number of id	45	45	45	36	36	45

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For Low income and Lower-middle-income countries, we continue to find the interactive effect of institutional variables measured by constraints on the executive and democracy to be positive and statistically significant. This suggests that improving the quality of institutions in poor countries that are endowed with natural resource can ensure that more sustainable revenues from other sectors of the economy are explored. We also find the interactive term with socioeconomic index also statistically significantly different from zero, signifying that the socio-economic environment matters for turning natural resource endowment into an avenue for expanding the domestic revenue potential of an economy. The marginal effect of resource rents on non-resource tax effort at the mean level of exconst is not qualitatively different from than in the full sample (-0.06). Similarly, the marginal effect of resource rents on non-resource tax effort at the mean level of the socioeconomic index (4.08 points) is slightly lower at -0.05.

However, when the socioeconomic index rises past an intermediate level of 5.67 points, the marginal effect of resource rents on non-resource tax effort turns positive (that is, using equations 1 and 2 to derive the turning point). Apart from institutional constraints on the executive, we expect that an improvement in the socioeconomic environment as characterized by, for example, reduced risks to unemployment and poverty, should contribute to mitigating the adverse effect of resource rents on non-resource tax effort. An environment that improves consumer confidence should boost both consumption and investment. These factors should, in turn, contribute to widening the tax base and increasing non-resource taxes.

Other variables that turn statistically significant for the sample of Low income and Lower-middle-income countries are log of GDP per capita, grants as a percentage of GDP, and trade openness, all of which turn positive in most specifications in Tables 22 and 23. All other things being equal, a larger output base would be associated with higher non-resource taxes.

Furthermore, developing countries stand to gain from grant support, especially those allocated to building fiscal capacity and increasing the production base. Many developing countries continue to depend on trade taxes as an important part of their tax base. The positive association between trade openness and non-resource tax effort is therefore not a surprising result for Low income and Lower-middle-income countries. Once again, agriculture value-added turns negative and statistically significant in accordance with our expectation, albeit with respect to only column four of Table 22 and columns four and five of Table 23. A marginal increase in agriculture's percentage of GDP is associated with a reduced non-resource tax effort.

These results are largely consistent with those of the full global sample. Essentially, constraints on the executive mitigate the adverse effect of resource rents on non-resource tax effort. The effect of institutional quality is however weak and therefore unable to overturn the resource curse in most specifications.

3.4.1.2 Marginal Effects Beyond the Short-run

In Tables 24 and 25, we go beyond the contemporaneous effect to examine the marginal effects of total resource rents on non-resource tax effort in the medium-term. We transform the data into five-year non-overlapping averages. In the medium-term, we find that the interaction terms involving all institutional variables except bureaucratic quality and law and order are not statistically significant. These statistically significant coefficients are also negatively signed, contrary to what one would expect. It suggests that an improvement in law and order (as well as bureaucratic quality) exacerbates the deleterious impact of resource rents on non-resource tax effort.

In both Tables 24 and 25, other variables such as improvement in the control of corruption index score and GDP per capita are associated with improvements in non-resource tax effort. We also find an increase in agricultural value-added as a percentage of GDP to be associated with a reduction in non-resource tax as a percentage of GDP.

Table 24: Interactive Effect with Political Institutions - Beyond the short-run (Global Sample)

Dependent Variable: Non-resource tax revenue as a percentage of GDP					
VARIABLES	(1) OLS	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.133*** (0.0230)	-0.0908** (0.0396)	-0.120*** (0.0395)	-0.136*** (0.0452)	-0.175*** (0.0558)
polity2	0.196*** (0.0683)	-0.0261 (0.0821)	-0.0171 (0.0868)		
c.t_rent2gdp#c.polity2	0.00286 (0.00549)	0.00483 (0.00441)	0.00152 (0.00444)		
democ_ed				-0.0488 (0.135)	
c.t_rent2gdp#c.democ_ed				0.00591 (0.00678)	
Eiec					-0.0641 (0.213)
c.t_rent2gdp#c.eiec					0.00883 (0.00947)
Grants	-0.0635 (0.131)	0.0409 (0.179)	0.00233 (0.171)	-0.00244 (0.169)	-0.0276 (0.159)
Corrupt control	1.145*** (0.322)	0.447 (0.312)	0.794** (0.397)	0.763* (0.390)	0.816** (0.331)
agricval2GDP	0.00308 (0.0322)	-0.0931*** (0.0286)	-0.0773*** (0.0293)	-0.0755** (0.0297)	-0.0620* (0.0317)
Log GDP per capita	1.164*** (0.407)	1.534*** (0.587)	1.151** (0.572)	1.208** (0.577)	1.121** (0.545)
trade2GDP2	0.00629 (0.00629)	0.00513 (0.00790)	0.00202 (0.00805)	0.00159 (0.00796)	0.00464 (0.00802)
Country effect	No	Yes	Yes	Yes	Yes
Period effect	No	No	Yes	Yes	Yes
Observations	418	418	418	418	447
R-squared	0.401				
Number of id	93	93	93	93	97

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 25: Interactive Effect with Other Types of Institutions: Beyond the short-run (Global Sample)

Dependent Variable: Non-resource tax revenue as a percentage of GDP					
VARIABLES	(1)	(2)	(3)	(4)	(5)
	REE	REE	REE	REE	REE
t_rent2gdp	-0.1000 (0.0777)	-0.125** (0.0501)	-0.140*** (0.0495)	-0.0618 (0.0445)	0.0514 (0.0615)
liec	0.121 (0.295)				
c.t_rent2gdp#c.liec	-0.00546 (0.0124)				
checks		-0.144 (0.131)			
c.t_rent2gdp#c.checks		-0.00122 (0.0106)			
exconst_ed			0.102 (0.266)		
c.t_rent2gdp#c.exconst_ed			0.00739 (0.0107)		
bureacr				0.233 (0.451)	
c.t_rent2gdp#c.bureacr				-0.0490* (0.0256)	
laworder					1.038*** (0.392)
c.t_rent2gdp#c.laworder					-0.0618*** (0.0193)
grants	-0.0197 (0.157)	-0.00627 (0.161)	-0.0234 (0.166)	-0.0233 (0.158)	0.00502 (0.139)
Corrupt control	0.840** (0.326)	0.836** (0.331)	0.732* (0.392)	0.778** (0.345)	0.638** (0.293)
agricval2GDP	-0.0716** (0.0318)	-0.0800** (0.0319)	-0.0709** (0.0308)	-0.0823** (0.0332)	-0.0838** (0.0326)
Log GDP per capita	0.965* (0.546)	0.957* (0.558)	1.141* (0.585)	1.052* (0.540)	0.747 (0.529)
trade2GDP2	0.00634 (0.00810)	0.00606 (0.00796)	0.000981 (0.00784)	0.000583 (0.00710)	-0.000581 (0.00714)
Country Effect	Yes	Yes	Yes	Yes	Yes

Period Effect	Yes	Yes	Yes	Yes	Yes
Observations	447	447	418	453	453
Number of id	97	97	93	99	99

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

In Table 26, none of the interaction terms turns statistically significant. The coefficient on agriculture as a percentage of GDP remains negative and statistically significant across all specifications. Other covariates such as grants as a percentage of GDP, corruption index, trade openness and GDP per capita, which captures the size of the economy, turn statistically significant in two specifications each.

Table 26: Interactive Effect with Measures of Effectiveness of Government: Beyond the short-run (Global Sample)

Dependent Variable: Non-resource tax revenue as a percentage of GDP				
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE
t_rent2gdp	-0.0639 (0.0708)	-0.113** (0.0512)	-0.606 (0.374)	-0.573 (0.372)
investprof	-0.0459 (0.187)			
c.t_rent2gdp#c.investprof	-0.00838 (0.00818)			
socioecon		-0.0399 (0.180)		
c.t_rent2gdp#c.socioecon		-0.00269 (0.00985)		
cpia_erm			0.943 (2.016)	
c.t_rent2gdp#c.cpia_erm			0.135 (0.119)	
cpia_prop				-0.389 (1.737)
c.t_rent2gdp#c.cpia_prop				0.149 (0.128)
grants	0.000542 (0.164)	-0.0219 (0.160)	0.334** (0.136)	0.291** (0.140)
Corrupt control	0.826** (0.326)	0.796** (0.321)	-0.485 (0.759)	-0.347 (0.730)
agricval2GDP	-0.0831** (0.0350)	-0.0721** (0.0314)	-0.130** (0.0573)	-0.168** (0.0681)
Log GDP per capita	1.037* (0.554)	1.107* (0.580)	0.352 (1.035)	-0.165 (1.292)
trade2GDP2	0.00274 (0.00735)	0.00219 (0.00731)	0.0725*** (0.0157)	0.0774*** (0.0165)
Country Effect	Yes	Yes	Yes	Yes
Period Effect	Yes	Yes	Yes	Yes
Observations	453	453	71	71
Number of id	99	99	41	41

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We re-examine these results for LICs and LMICs in Tables 27 and 28. In Table 27, the interaction terms that turn statistically significant are those comprising the legislative index of electoral competitiveness and law and order. Both are however negatively signed for the developing country sample. This suggests that for developing countries, resource rents undermine bureaucratic quality and law and order.⁴¹ The finding somewhat resonates with the resource rents and governance literature, which finds a ‘positive’ association between resource rents on one side and conflicts, break down in governance on another (Knutsen, Kotsadam, Olsen, & Wig, 2017; Caselli & Tesei, 2016; Williams, 2011; Collier & Hoeffler, 2009; Knack, 2009). Natural resource finds trigger contests for ownership and control over its exploitation. This breeds conflicts, sometimes between state and multinational companies involved in production on one side and citizens on the other. Control over natural resources has also been known to breed rent-seeking behaviour among the elites who control the resources. These possibilities therefore dampen attempts to improve non-resource tax effort. On the other hand, the coefficient on grants, trade openness and GDP per capita all turn statistically significant at the one percent level.

⁴¹ Another way of interpreting the result is that improvements in the quality of these institutions actually worsens the negative impact of natural resource rents on non-resource tax effort. While this result sounds puzzling, it perhaps identifies possible costs to improving role of institutions in the presence of natural rents and requires more exploration.

Table 27: Interactive Effect with Different Types of Institutions: LICs and LMICS (Beyond short-run)

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE	(6) REE
t_rent2gdp	-0.128*** (0.0474)	-0.134** (0.0595)	-0.0761 (0.0767)	-0.0411 (0.0755)	-0.107 (0.0719)	0.0323 (0.0917)
polity2	0.0225 (0.0794)					
c.t_rent2gdp#c.polity2	0.000570 (0.00563)					
democ_ed		0.0195 (0.147)				
c.t_rent2gdp#c.democ_ed		0.00300 (0.00884)				
eiec			0.252 (0.234)			
c.t_rent2gdp#c.eiec			-0.0109 (0.0108)			
liec				0.388** (0.183)		
c.t_rent2gdp#c.liec				-0.0171* (0.00996)		
exconst_ed					0.337 (0.241)	
c.t_rent2gdp#c.exconst_ed					-0.00443 (0.0137)	
laworder						0.912** (0.409)
c.t_rent2gdp#c.laworder						-0.0777*** (0.0301)
grants	0.424*** (0.138)	0.420*** (0.141)	0.418*** (0.139)	0.408*** (0.142)	0.384*** (0.144)	0.470*** (0.137)
Corrupt control	0.0666 (0.460)	0.0542 (0.475)	0.0808 (0.474)	0.117 (0.474)	0.0514 (0.453)	0.0745 (0.467)
agricval2GDP	-0.0338 (0.0264)	-0.0331 (0.0275)	-0.0375 (0.0267)	-0.0375 (0.0250)	-0.0318 (0.0293)	-0.0381 (0.0270)
Log GDP per capita	2.145*** (0.745)	2.184*** (0.746)	1.935*** (0.689)	1.800*** (0.638)	2.039*** (0.707)	1.906*** (0.592)

trade2GDP2	0.0455*** (0.0111)	0.0445*** (0.0112)	0.0490*** (0.0101)	0.0501*** (0.0101)	0.0440*** (0.0104)	0.0528*** (0.00860)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212	212
Number of id	47	47	47	47	47	47

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table 28, the interaction terms comprising checks and balances and investment profile index turn negative and statistically significant, thus contributing to the fiscal resource curse. For the developing country sample, the negative association of the interactive term comprising investment profile and non-resource tax effort perhaps reflects increasing concerns about international taxation. The latter include base erosion and corporate profit shifting, transfer mispricing and other practices foreign firms engage in to avoid tax (Forstater, 2018)⁴². Countries lacking the capacity to manage large foreign firms operating within their jurisdiction are prone to this challenge. In Table 28, we find a statistically significant association between the interactive term comprising institutional efficiency in revenue mobilization and non-resource tax effort. The statistical significance is however only at the 10 percent level. Nonetheless, the finding suggests that the level of institutional efficiency in mobilizing domestic revenues mitigates the adverse impact of resource rents on non-resource tax effort. Similar to Table 27, most of the specifications in Table 28 for covariates such as grants as a percentage of GDP, trade openness and GDP per capita turn positive and statistically significant at the one percent level. The coefficient on agriculture as a percentage of GDP is negative and statistically significant in most of the specifications as well.

⁴² Forstater (2018) however notes that resolving domestic bottlenecks to revenue mobilization is of greater importance.

Table 28: Interactive Effect with Other Types of Institutions (II): LICs and LMICs (Beyond short-run)

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE	(6) REE
t_rent2gdp	-0.0787 (0.0509)	-0.101 (0.0725)	-0.00898 (0.0879)	-0.162** (0.0825)	-0.739** (0.357)	-0.644* (0.363)
checks	0.116 (0.162)					
c.t_rent2gdp#c.checks	-0.0206** (0.00802)					
bureacr		0.400 (0.564)				
c.t_rent2gdp#c.bureacr		-0.0242 (0.0394)				
investprof			0.244 (0.260)			
c.t_rent2gdp#c.investprof			-0.0193** (0.00974)			
socioecon				-0.0238 (0.243)		
c.t_rent2gdp#c.socioecon				0.0106 (0.0140)		
cpia_erm					1.140 (1.986)	
c.t_rent2gdp#c.cpia_erm					0.189* (0.113)	
cpia_prop						-0.242 (1.867)
c.t_rent2gdp#c.cpia_prop						0.191 (0.129)
grants	0.459*** (0.131)	0.440*** (0.140)	0.445*** (0.134)	0.426*** (0.135)	0.369** (0.150)	0.283* (0.146)
Corrupt control	0.144 (0.483)	0.0348 (0.469)	0.0521 (0.451)	0.108 (0.482)	-0.831 (0.781)	-0.669 (0.732)
agricval2GDP	-0.0464* (0.0264)	-0.0313 (0.0285)	-0.0499* (0.0258)	-0.0337 (0.0279)	-0.143*** (0.0518)	-0.185*** (0.0665)
Log GDP per capita	1.914*** (0.645)	2.231*** (0.783)	1.925*** (0.640)	1.986*** (0.749)	-0.210 (0.943)	-0.874 (1.254)

trade2GDP2	0.0503*** (0.0102)	0.0442*** (0.0114)	0.0498*** (0.00946)	0.0442*** (0.0112)	0.0689*** (0.0155)	0.0756*** (0.0148)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	66	66
Number of id	47	47	47	47	37	37

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.4.1.3 Robustness Checks

First, we examine whether our baseline results are robust to the inclusion of additional list of control variables. Following Mawejje (2019) and Masi et al. (2018), we control for log of population and log of consumer price index to account for the potential size of the labour force and the general price level prevailing in a country over time. Several studies also account for the level of population or population density in explaining tax revenues (Botlhole et al., 2012). The argument is that countries with higher populations are likely to have a larger labour force and a larger consumer base. This has implications for the tax base and therefore the amount of taxes raised. Furthermore, countries suffering persistent inflation would have a depressed non-resource tax revenue level as the real value of the taxes raised declines. This is referred to as the Oliveira-Tanzi effect. Moreover, higher prices which lead to demands for higher wages would mean lower demand for labour and therefore lower output for producers. This could translate to a narrower tax base. To test the plausibility of these arguments, we include these additional covariates and reproduce specifications involving interaction terms that turns statistically significant at conventional levels (i.e. from short-run results). These variables include `polity2`, `exconst_ed`, `democ_ed`, `liec` and `socioecon`.

In Table 29, we find that the coefficients of the additional list of control variables are not statistically significantly different from zero. Furthermore, the results are largely consistent with the baseline line results. The interactions terms involving `polity2`, `exconst_ed` and `democ_ed` all turn statistically significant with coefficients of comparable size to our baseline results. The interaction term with `socioecon` and `checks` are however not statistically significant. The result in Table 29 thus supports the evidence that like democracy, constraints on the executive has a moderating effect on the adverse effect of resource rents on non-resource tax effort although the marginal effects remain negative.

As expected, the coefficients on control of corruption and GDP per capita turn positive and statistically significant at conventional levels.

Table 29: Robustness checks with additional control variables (Global Sample)

Dependent variables: non-resource tax as a percentage of GDP					
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.0529 (0.0336)	-0.121*** (0.0325)	-0.0906*** (0.0315)	-0.0891*** (0.0319)	-0.0788 (0.0679)
polity2	-0.00683 (0.0584)				
c.t_rent2gdp#c.polity2	0.00597** (0.00296)				
exconst_ed		0.125 (0.134)			
c.t_rent2gdp#c.exconst_ed		0.0208*** (0.00556)			
democ_ed			0.00719 (0.0921)		
c.t_rent2gdp#c.democ_ed			0.0144*** (0.00426)		
checks				-0.198** (0.0989)	
c.t_rent2gdp#c.checks				0.0132 (0.0108)	
socioecon					-0.109 (0.135)
c.t_rent2gdp#c.socioecon					0.00562 (0.0114)
lnapi	-0.120 (0.0875)	-0.102 (0.0783)	-0.110 (0.0808)	-0.0716 (0.0753)	-0.0865 (0.0888)
lnpop	0.639 (0.565)	0.638 (0.586)	0.667 (0.585)	0.629 (0.587)	0.676 (0.606)
grants	0.0518 (0.0791)	0.0186 (0.0748)	0.0415 (0.0785)	0.0499 (0.0756)	0.0544 (0.0766)
Corrupt control	0.454* (0.259)	0.449* (0.255)	0.434* (0.257)	0.473*** (0.179)	0.504*** (0.186)
agricval2GDP	-0.0435 (0.0386)	-0.0257 (0.0347)	-0.0312 (0.0355)	-0.0460 (0.0353)	-0.0497 (0.0404)
Log GDP per capita	1.728** (0.710)	1.736** (0.686)	1.725** (0.692)	1.762** (0.695)	1.713** (0.764)

trade2GDP2	0.00570 (0.00803)	0.00457 (0.00769)	0.00565 (0.00786)	0.00929 (0.00826)	0.00931 (0.00754)
Country Effects	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,652	1,653	1,653	1,755	1,805
Number of id	91	91	91	95	97

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We further examine the robustness of our results in the medium-term, where we transform the data into semi-decadal series. To do this, we employ a Generalized Methods of Moments estimator for the following reasons. First, it enables us to take advantage of internal instruments to correct for possible endogeneity of our explanatory variables of interest. In addition, a negative or positive shock to non-resource tax revenues could be persistent over time hence the need to test for a dynamic effect. Furthermore, there could be an instance of simultaneity bias. Persistently low revenues could incentivize a country's focus on the resource sector. It could also weaken institutions as there are fewer sources of stable and sustainable financing or simply encourage corruption. Finally, our case of large N (number of countries) and short T (due to our collapsing of the annual time series into semi-decadal series) offers the opportunity to employ an Arellano and Bond estimator to examine the robustness of our results⁴³.

⁴³ For large T, this method would not be appropriate for examining the robustness of the short-term results because as Roodman (2006) notes, using such an estimator in the case of large T increases the problem of instrument proliferation and weakens the Hansen test.

Table 30: Interactive Effect with Types of Institutions using GMM: Beyond short-run (Global Sample)

Dependent Variable: Non-resource tax revenue as a percentage of GDP						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
L.tot_nrestax	0.804*** (0.170)	0.740*** (0.225)	0.626* (0.340)	0.279 (0.717)	0.438 (0.307)	0.834*** (0.216)
t_rent2gdp	-0.0240 (0.0659)	-0.107 (0.0930)	-0.218 (0.214)	-0.825 (1.838)	-0.407* (0.227)	-0.0972 (0.0914)
polity2	-0.0795 (0.143)					
c.t_rent2gdp#c.polity2	0.00954 (0.00774)					
grants	-0.0307 (0.111)	-0.0375 (0.113)	-0.0643 (0.121)	-0.0156 (0.254)	0.0917 (0.181)	-0.0444 (0.0888)
Corrupt control	0.506 (0.893)	0.509 (0.843)	0.938 (0.794)	0.307 (1.794)	0.0577 (0.821)	0.370 (0.750)
agricval2GDP	-0.0462* (0.0245)	-0.0324 (0.0299)	-0.0177 (0.0304)	0.00628 (0.0699)	-0.00903 (0.0413)	-0.0303 (0.0240)
Log GDP per capita	-0.224 (0.500)	0.121 (0.569)	0.156 (0.799)	1.504 (2.852)	1.259 (1.056)	-0.130 (0.485)
trade2GDP2	-0.00358 (0.00843)	-0.00451 (0.00953)	-0.000908 (0.00729)	0.00531 (0.0159)	-0.00201 (0.0104)	-0.00354 (0.00664)
democ_ed		-0.224 (0.245)				
c.t_rent2gdp#c.democ_ed		0.0230* (0.0128)				
eiec			-0.287 (0.650)			
c.t_rent2gdp#c.eiec			0.0316 (0.0308)			
liec				-1.521 (4.643)		
c.t_rent2gdp#c.liec				0.118 (0.277)		
checks					-1.734 (1.425)	
c.t_rent2gdp#c.checks					0.107* (0.0575)	

exconst_ed						-0.149
						(0.367)
c.t_rent2gdp#c.exconst_ed						0.0272
						(0.0166)
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
AR(1) P-Values	0.025	0.04	0.16	0.26	0.24	0.04
AR(2) P-Values	0.39	0.54	0.67	0.74	0.67	0.37
Hansen J (P-Values)	0.2	0.2	0.17	0.54	0.57	0.19
Number of Instruments	20	20	20	20	20	20
Observations	374	377	401	401	401	377
Number of id	90	90	94	94	94	90

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

In Table 30, the interaction terms with “checks” and “democracy” turn positive and statistically significant at the 10 percent level. The result on democracy is consistent with earlier evidence (for example see Table 29). We also find the coefficient on agriculture value as a percentage of GDP to be negative and statistically significant at conventional levels in column one of Table 30. In Table 31, the interaction terms are not statistically significant except for bureaucratic quality, which turns negative. The coefficient on agriculture value-added remains negative in both columns 1 and 2.

Table 31: Interactive Effect with Type of Institutions using GMM (II): Beyond short-run (Global Sample)

Dependent Variable: Non-resource tax revenue as a percentage of GDP				
VARIABLES	(1)	(2)	(3)	(4)
L.tot_nrestax	0.951*** (0.300)	1.020*** (0.287)	-0.0717 (0.501)	0.534 (0.410)
t_rent2gdp	0.434 (0.280)	0.308*** (0.104)	-0.499* (0.272)	0.0859 (0.104)
laworder	1.122 (1.359)			
c.t_rent2gdp#c.laworder	-0.108 (0.0813)			
grants	0.0149 (0.157)	0.0507 (0.0882)	0.0745 (0.163)	0.0391 (0.141)
Corrupt control	0.795 (0.925)	-0.00918 (0.843)	0.511 (0.622)	0.669 (1.099)
agricval2GDP	-0.0844** (0.0339)	-0.0799*** (0.0257)	0.0201 (0.0642)	-0.0525 (0.0418)
Log GDP per capita	-0.776 (0.963)	-0.633 (0.758)	2.025 (1.447)	0.228 (0.926)
trade2GDP2	-0.00925 (0.00877)	-0.00562 (0.00407)	0.00157 (0.0102)	-0.00604 (0.00983)
bureacr		1.095 (0.858)		
c.t_rent2gdp#c.bureacr		-0.142** (0.0616)		
investprof			-0.608 (0.384)	
c.t_rent2gdp#c.investprof			0.0283 (0.0255)	
socioecon				0.361 (0.582)
c.t_rent2gdp#c.socioecon				-0.0279 (0.0244)
Country Effects	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes
AR(1) P-Values	0.12	0.04	0.85	0.31
AR(2) P-Values	0.11	0.18	0.26	0.6
Hansen J (P-Values)	0.17	0.27	0.29	0.16
Number of Instruments	20	20	20	20
Observations	406	406	406	406
Number of id	96	96	96	96

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Once we restrict the sample to lower-income and lower-middle-income countries, our results are largely re-enforced as we see no robust role for institutions irrespective of the type. This is also the case once we identify and remove outliers from the full sample using a two-step revamped Hadi procedure implementable with Stata (Weber, 2010; Billor, Hadi, & Velleman, 2000)⁴⁴. The procedure calculates the Mahalanobis distance for each observation from the whole sample (see Billor et al. (2000) for algorithms). The Stata procedure generates a dummy variable with value one for outliers and zero otherwise. On the other hand, we notice that the coefficient on variables such as corruption, agriculture and trade openness turn statistically significant with the expected signs in some specifications (see Table 8 of Appendix B).

3.5 Chapter Summary

In this chapter, we explore the role of institutions in mediating the relationship between resource rents and non-resource tax effort. We examine whether institutions exact any moderating influence on the effect of resource booms on non-resource tax effort. Thus, the focus is on whether the type and quality of institutions in place matters for improving fiscal outcomes and thus diversifying the tax base in the presence of rents from natural resources. To do this, we construct a theoretical model to contribute to our understanding of the influence of institutions on the relationship between natural resource rents and non-resource tax effort. The main predictions of the model suggest that the mitigating impact of institutions on the relationship between resource rents and non-resource tax effort is at best weak, even if existent. We test a key insight from the prediction by exploring the role of different types of institutions on the relationship. Our empirical analysis suggests that while institutional variables such as constraints on the executive and democracy may be important in the short-run as they exact a

⁴⁴ In the first step, we determine outliers using only non-resource tax as a percentage of GDP and total resource rents as a percentage of GDP. In the second step we identifier outliers from the full sample with the full list of control variable variables.

moderating influence on the effect of natural resource rents on non-resource tax effort, their overall impact on the fiscal resource curse is weak.⁴⁵ In effect, institutional quality alone is unable to overturn the adverse effect of resource rents on non-resource tax effort, especially when export prices are high. This evidence persists beyond the short-run and is particularly relevant for developing countries. The results are also consistent with the inclusion of additional covariates and the removal of outliers as part of our robustness checks. With regards to effort to improve non-resource tax effort, we also find that other variables are likely to be equally important if not more so, relative to the quality of institutions. These variables include the level of GDP per capita in an economy, the level of informality in the economy and control of corruption. Other key variables that turn statistically significant are the volume of trade and the level of grants as a percentage of GDP.

These results ought to be interpreted with caution as they do not imply that institutions do not matter. On the contrary, they show that improving the quality of public institutions alone without strengthening other fundamental factors relevant for improving non-resource effort would not undo the fiscal resource curse. In addition to improving the quality of institutions, growing the size of the economy, addressing the level of informality, unshackling international trade and controlling corruption are essential ingredients to expanding the tax base and increasing non-resource tax revenues.

⁴⁵ Note that we also find a statistically significant effect for *polity2*, which is a higher aggregated measure of the quality of democratic institutions. It does not turn statistically significant in every specification where its constituent variables *exconst_ed* and *democ* does. Perhaps, our results also show that while there are strengths in aggregating indices, there are limitation to what they can reveal at a certain level of aggregation.

CHAPTER FOUR

4.0 DOES TYPE OF NON-RENEWABLE RESOURCE IMPACT DIFFERENTLY ON NON-RESOURCE TAX EFFORT?

Chapter four examines the differential impact of different types of non-renewable natural resource on non-resource tax effort. The theoretical and empirical framework distinguishes between two categories of non-renewable resources: hydrocarbons and minerals. There are 5 sections to this chapter spanning a literature review, a theoretical framework, an empirical framework and a presentation of results and discussions. The final section provides a chapter summary.

4.1 Literature Review

4.1.1 Introduction

A strand of literature on the natural resource curse distinguishes between and among different types of renewable and non-renewable natural resources. This is partly due to the view that assessing the impact of natural resources in a composite manner, may obscure understanding their individual impacts (Leite & Weidmann, 1999). There are studies that distinguish between ‘point’ sources and ‘diffused’ sources of natural resources. The former occurs in a limited or confined geographical space and therefore is easily appropriable while the latter refer to sources that are scattered across a geographical space ⁴⁶. Point sources may include hydrocarbons and minerals, while diffused sources are usually made up of products of agriculture (Yanikkaya & Turan, 2018; Alexeev & Chernyavskiy, 2015; Isham, Woolcock, Pritchett, & Busby, 2005; Sala-i-martin & Subramanian, 2003).

⁴⁶ The notion of being appropriable also speaks to the ease of extraction, storage, transportation and sales (Boschini et al., 2007).

There are also studies that distinguish between types of points sources. For example, Andersen & Aslaksen (2013) distinguish between technically appropriable point sources such as minerals and ‘lootable diamonds’ and least technically appropriable sources such as oil and ‘non-lootable diamonds’. Others also examine the impact of hydrocarbon endowment on development outcomes as different from the impact of minerals and metals (Prichard, Salardi, & Segal, 2018; Knack, 2009; Karl 1997). Our study follows the latter distinction. The rationale stems from the fact that the costs and benefits associated with both groups of sources differ. The issues surrounding the contracting process, cost of extraction and pricing coupled with public policy towards taxing them implies that natural resources are not homogeneous (Readhead, 2018; Alexeev & Chernyavskiy, 2015). Consequently, the incentives facing governments to mobilize either or both groups of resources and how that translates into non-resource tax effort cannot be assumed to be homogenous.

In this chapter, we examine theoretically and empirically, whether the effect of natural resource rents on non-resource tax effort is distinguished by the type of natural resource. We explore this question first from a global perspective, using the full sample of developed and developing countries. We then look at the evidence for developing countries only, followed by a sub-sample made up of Low-income (LICs) and Lower-middle-income Countries (LMICs). The use of different samples allows us to examine whether context matters in understanding the relationship between different types of natural resources and non-resource tax effort.

4.1.2 Resource-type Dimension of the Natural Resource Curse

There is growing evidence that suggests that different types of natural resources exert different outcomes on governance, economic growth, public spending, revenue capacity and other

development outcomes (see, for example, Yanikkaya & Turan, 2018; Bhattacharyya, Conradie, & Arezki, 2017; Boschini, Pettersson, & Roine, 2013; Fosu, 2013; El Anshasy & Katsaiti, 2013; Knack, 2009; Petermann, Guzmán, & Tilton, 2007). Studies in this area comprise cross-country analysis, country case studies, sub-national analysis and a combination of the aforementioned. For instance, in a combination of a cross-sectional study and a country case study on Nigeria, Sala-i-Martin & Subramanian (2013) find an adverse impact of fuel and metal resources on growth through its delirious impact on institutional quality⁴⁷. They test the effect of fuel and metal resources against that of agricultural raw materials and food. They find that the coefficients on the latter were generally not statistically significant. Earlier studies by Isham et. al (2005), Bulte, Damania, & Deacon, (2005) and Leite & Weidmann (1999) draw similar conclusions. According to the literature, point sources such as fuel and metal resources fuel corruption and undermine economic growth and development. This is because they are more likely to be “centrally controlled” and therefore easier to appropriate (Boschini et al., 2013). The ease of appropriating point sources facilitates rent-seeking behaviour.

On the other hand, diffused natural resources such as food crops and raw materials from the agricultural sector do not exert such negative influence. Smith (2004) however contests the negative view of fuel minerals (oil) on governance. Using panel data on 107 developing countries over the period 1960 to 1999, he finds a positive effect of oil wealth on the survival of political regimes. More recent studies seem to confirm this view, especially for authoritarian regimes (Andersen & Asleksen, 2013; Omgba, 2009; Ross, 2008). Using a Generalized Method of Moments estimator for more than 100 countries over a nine-period five-year series, starting from 1970-1974, Yanikkaya & Turan (2018) finds a positive effect of hydrocarbon and mineral

⁴⁷ See also Andersen and Asleksen (2013) for country case studies on effect of resource wealth on political institutions.

rents on growth. For instance, natural resources provide revenues for investing in productive assets, which in turn drive growth. The authors, however, find the effect of forest rents on growth to be negative. Forest rents are mobilized through degrading forests, which result in loss of biodiversity.

Presenting distinctions between agricultural and non-agricultural commodities, Collier & Goderis, (2009) find that the former has a positive effect on growth while the latter evicts growth. Again, while contrary views exist, there is also evidence for more nuanced perspectives. Andersen & Asleksen (2013), find that oil and 'non-lootable' diamonds are associated with longer survivals of governments whereas countries with minerals and 'lootable' diamonds seem to have more cases of political instability. Dietz, Neumayer, & De Soysa (2007) present yet another nuanced view, taking the quality of institutions into account. They argue that natural resource exploitation does increase genuine savings (that is, adjusted net savings according to the World Bank's definition) in the presence of good institutions. Although they distinguish among different types of resources, they do not examine their differential impact on savings. Petermann et al. (2007) finds that non-fuel minerals could have a positive or negative effect on corruption, depending on the country. According to the authors, in high-income countries, non-fuel minerals reduce corruption. Countries with high per capita income are associated with better institutions, which helps to control corruption. Petermann et al. (2007), however, find the effect of fuel minerals on corruption to be unambiguously negative.

Similarly, Boschini et al. (2013), distinguishes among four types of natural resources: agricultural raw materials, food, ore and metals and fuel minerals. Using panel data and methods, with period spanning from 1965 to 2005, they find the negative effects of resource

rents on growth is mainly driven by ore and metals relative to the other types of resource rents. Boschini et al. (2007) and Isham et al. (2005) also make a similar distinction among these resource types, classifying them as either point sources or diffuse sources of natural resources. Prichard et al. (2018) employ the ICTD- GRD database to examine the political resource curse: the idea that resource dependence undermines democracy. Using panel data methods including a Generalized Method of Moments estimator, Mean Group Estimator and a Random and Fixed Effect Logit estimator, they find evidence of a political resource curse. However, they find the evidence to be stronger for oil-producing countries than for non-oil producing countries. They explain that relative to non-oil resources, oil endowments are easier to convert into government revenues. The result is a probable expansion in patronage, rent-seeking behaviour among the ruling elite and less dependence on citizens for taxation, which in itself deprives a state from building its democratic institutions.

Using Fixed-effects and Arellano and Bond estimators, Alexeev & Chernyavskiy (2015) examine the effect of different types of point sources on growth outcomes at the regional level in Russia. Prior to examining the regional estimates, the authors find a positive effect of hydrocarbon resources on growth from the year 2002 to 2011 at the national level. However, this effect is not evident at the regional level, turning negative in some instances. The reason they provide for the negative effect is due to the taxes imposed by the Russian government on oil rents. On the other hand, the effect of non-hydrocarbon minerals is found to be positive at the regional level for the period.

4.1.3 Resource-type dimension of the Fiscal Resource Curse

Granted that different types of natural resources impact differently on diverse measures of development outcomes, we explore this differential impact on fiscal capacity. Bhattacharyya

et al. (2017) uses a Fixed-effects estimator and an instrumental variable approach to examine the effect of resource rents on fiscal centralization (as against decentralization). Using panel data for 77 countries over the period 1970-2012, they find that an increase in oil rents is more likely to trigger fiscal centralization as compared to mineral rents. The incentives provided by oil rents make central governments less willing to lose control over its management.

In another study of 60 countries, using dynamic panel methods for the period 1970 to 2010, Klomp & de Haan (2016) show that rents from energy resources (oil and gas) promote political business cycles. Incumbent governments use the rents to increase public spending or reduce taxes when elections are near. They, however, do not find such effects when rents come from minerals, metal and forest resources. Botthole et al. (2012) argue that non-renewal resources have a more adverse effect on total tax effort (tax revenue as a percentage of GDP) than renewable natural resources due to the incentives the former presents for rent-seeking. In a sample of 45 SSA countries over the period 1990 to 2007, they employ a Two-Stage Least Squares instrumental variable strategy to examine this relationship. They find that minerals and energy resources do more harm to total tax effort than forestry resources.

In distinguishing between types of non-renewable resources, Knack (2009) finds that fuel mineral exports exert a more deleterious impact on tax systems compared to ore and metal exports. He finds the effect of the latter not to be statistically significantly different from zero. The results are based on a cross-sectional econometric study involving a 110-country sample. The tax system measure is a variable from the World Bank's Country Policy Institutional Assessment (CPIA) ratings - 'Efficiency of Revenue Mobilization'. In particular, the type of resource defines and influences the tax regimes that countries apply and eventually the tax effort (International Monetary Fund, 2015). Various factors including the cost of exploitation

of the different types of natural resources accounts for this. Thus, we would not expect the same non-resource revenue outcomes for countries that produce or have different natural resource endowments.

4.1.4 Contribution to the literature

We build on the evidence that different types of non-renewal resources exert different impacts on development and in particular, fiscal outcomes. We contribute to deepening the understanding of the differential impact of type of non-renewable resources on fiscal capacity, which we define differently. Since we are interested in sustainable sources of tax revenues, we define fiscal capacity as non-resource tax revenues as a percentage of GDP. We stay consistent with our quest to understand fiscal capacity outside the (non-renewable) resource sector by focusing on non-resource tax effort rather than total tax effort as covered in other literature (for instance Botlhole et al., 2012).

We also take advantage of the ICTD-GRD database as an alternative data source to the resource rents data provided in the World Bank's World Development Indicators. The data provides the opportunity to extend the sample and the time dimension significantly beyond what we are aware is covered in the literature. We distinguish between hydrocarbons and non-hydrocarbon minerals producing countries using complementary data sources than rank countries based on their production data. Consequently, we are able obtain a sample of countries with resource revenues mainly from hydrocarbon sources versus those that earn revenues from non-hydrocarbon sources. In order to take advantage of the full dataset, we use a dummy variable approach in distinguishing between hydrocarbon-producing countries and non-hydrocarbon producing countries. We go beyond the use of traditional estimators in the literature to explore the use of a Hausman-Taylor estimator. The latter accommodates the advantages of a fixed-

effects estimator with the use of internal instruments to address various sources of endogeneity. The use of the Hausman-Taylor estimator also means that key time-invariant covariates such as regional dummies, do not drop out of the estimations.

Finally, we widen the scope for understanding the evidence by examining different contexts. Related literature usually focused more on specific regions or specific set of countries, sometimes due to the challenges with data. We present the global evidence, then we assess the case for developing countries before probing the context for LICs and LMICs.

4.2 Theoretical Framework

The theoretical arguments underlying the natural and fiscal resource curse literature share similarities with those discussed when assessing the differential impact of types of natural resource on development outcomes and fiscal capacity in particular. This chapter, therefore, focuses more on discussing the distinguishing features of the theoretical arguments related to the differential impact of types of natural resources on fiscal capacity. We distinguish between hydrocarbon-producing countries and mineral-producing countries. The distinction relates with the different incentives provided by extraction of different types of natural resources due to their unique physical and economic characteristics. Freiden (1991) argues that the economic characteristics of an asset defines the policy preferences that owners hold⁴⁸. The characteristics, as earlier defined, may relate to the costs and benefits of extracting these resources. While the theoretical literature that specifically discusses the differential impact of different kinds of natural resources on fiscal capacity is relatively scant, there are key highlights from the broader literature that are worth noting.

⁴⁸ See Isham et al. (2005)

First, it is generally difficult to determine *apriori*, and with certainty, the cost and benefits associated with the extraction of a natural resource. Taking costs as an example, it might not be conclusive to argue that the exploitation of a particular type of resource, say hydrocarbons, within a particular geographical space is costlier than another, say minerals. While there exist standard cost centres for each type of resource, actual per-unit cost of exploitation even for the same resource may vary depending on how they occur as well as the surrounding geographical, socio-political and economic context. Similarly, projecting the benefits (including the anticipated wealth effect) from extracting the same resource let alone the two different sets of resources in different contexts can be speculative. That notwithstanding, there are industry standards and thus some basic calculations that are possible to appreciate the different costs and benefits associated with different natural resources. While the aim is not to explore the details of these calculations, our focus is to explore how these differences are accommodated in the decisions of a social planner, who is presented with the challenge of improving fiscal capacity⁴⁹.

We follow similar building blocks of the theoretical framework discussed in section 3.2. First, consider a social planner who has to decide on investing in fiscal capacity in a resource sector characterized by either minerals or hydrocarbons and a non-resource sector characterized by other goods and services outside the natural resource sector. The differing benefits and costs faced by the social planner in mobilizing revenue from the resource and non-resource sectors presents a dilemma regarding investing in fiscal capacity. This dilemma can be traced to the fundamental economic concept of scarcity. There are limited resources available to invest in fiscal capacity given that there are several other needs that exist. At another level, the incentive

⁴⁹ We recognize that there are geographical contexts where both types of resources occur however in most cases, the exploitation of one set is dominant relative to the other. Following Isham et al. (2005), we assume that the dominance of the exploitation of a particular resource over another is exogenous and related mainly to resource endowments.

to invest in fiscal capacity is determined by the anticipated net benefit ratio for each sector. We define the net benefit ratio as the difference between the present value of total benefits and the present value of total costs. Thus, the social planner would have to compare the net benefit ratios not just between sectors (first level) but also between types of resources (second level), in a situation where there are multiple resources.

There exist a determination and a choice to be made concerning which type of resource presents a higher net benefit ratio. In a scenario where only one type of resource is dominant then the first level of consideration applies. But even here, the fact that different countries may dominate in the extraction of one type of resource suggests that countries would have different experiences with regards to the effect of any type of resource on fiscal outcomes. With this variation, it is possible to examine which type of resource presents a greater complementary or displacement effect to non-resource tax effort. A resource type which carries a greater substitution effect would invariably exert a greater eviction effect of natural resources revenues/rents on fiscal capacity. It would have a more deleterious impact on non-resource tax effort while resource rents are being mobilized.

Following Andersen and Asleksen (2013) and others (Boschini et al, 2013; Boschini et al, 2007; Isham et al 2005), there is a theoretical argument to be made about how appropriable different types of resources are. According to this view, compared to many other minerals, oil is less appropriable. It requires huge capital outlays and a cumbersome regulatory arrangement that lies outside the control of non-state actors and the rest of the citizens. The costs associated with the extraction value-chain are therefore concentrated in the hands of a few (primarily the social planner and a few elites). It is the same with benefits or returns. The huge potential returns in the sector that accrues to a few means that political power is concentrated in the hands of

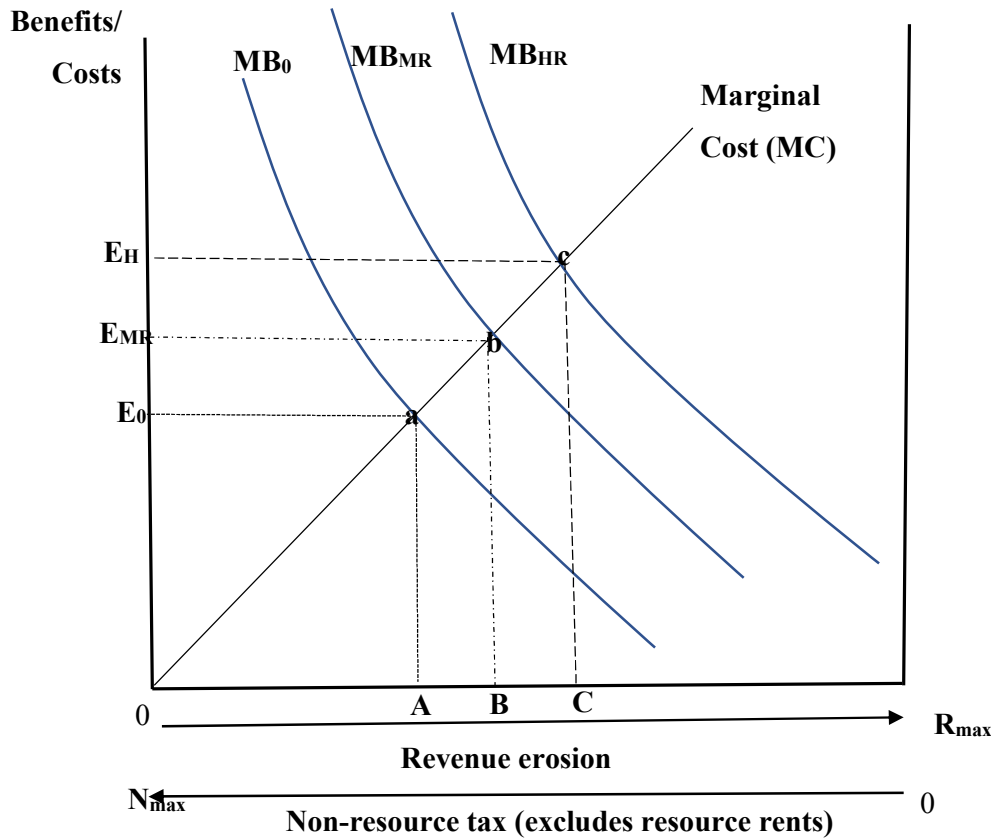
political elites. These elites, therefore, have the ability to determine who receives part of the rents in various forms (not precluding offering generous tax incentives). Furthermore, part of the rents could be used to prevent dissent, pacify voters and buy support in a way that can sustain a regime's survival and reduce accountability (Klomp & de Haan, 2016; Andersen & Asleksen, 2013).

On the other hand, mineral occurrence may be more widespread. Both the political elites and members of the opposition may have access to the resource. In such a situation, the cost, as well as returns from extraction, are spread across the groups. The power to distribute rents is, therefore, less concentrated in the hands of the social planner and elites. Given the benefits of exploitation of the minerals is more diffused, the willingness and ability of the social planner to distribute rents and buy political support is weakened. The social planner is in a weaker position to dole out tax incentives and to ignore revenue mobilization effort outside the resource sector. The extent of diffusion of minerals across a geographical space may also come with more difficulty in increasing the size of the revenue accruing to the social planner and therefore may warrant the need to expand the tax net.

We illustrate these possibilities in Figure 7 by extending a simple theoretical framework proposed by Knack (2009). The author examines how sovereign rents (windfall revenues) affects tax systems through the incentives it provides for granting tax exemptions in order to buy political support. The upshot is a reduction in tax effort, tax revenues and to a significant extent, contributing to weakening tax systems. Knack (2009) looks at tax systems in general. Figure 7, however, focuses on non-resource taxes, which invariably constitutes a broad base. In addition, while Knack (2009) looks at sovereign rents in general, Figure 7 differentiates

between types of sovereign rents: rents from hydrocarbons versus rents from minerals.⁵⁰

Figure 7: Relationship Between Type of Revenue Windfall and Non-Resource Tax Effort



Source: Author's construct, 2019, based on Knack (2009)

The horizontal axis shows two variables. From left to right, the Figure depicts declining total revenues as a result of increasing levels of tax exemptions, tax evasion and other forms of discretion in the enforcement of tax laws or revenue mobilization effort in general. This phenomenon is labelled as revenue erosion. From right to left, the Figure depicts increasing levels of non-resource tax revenues as a result of deliberate investment in fiscal capacity in the non-resource sector. Curves MB_0 , MB_{MR} , MB_{HR} show marginal benefit of revenue

⁵⁰ Knack further examines the impact of aid as a sovereign rent.

mobilization effort. The first curve (MB_0) shows marginal benefit without any natural resource revenue windfall (i.e. absence of natural resources). The second and third curves depict marginal benefits with mineral revenue windfall (MB_{MR}) and hydrocarbon revenue windfall (MB_{HR}) respectively. The monotonic decline in the marginal benefit curves reflect diminishing marginal returns and increasing administrative cost, distortionary effect of increasing taxation as well as other efficiency losses associated with domestic revenue mobilization (Knack, 2009). The upward-sloping marginal cost curve from left to rise corresponds to the efficiency losses and reflects increasing costs to the economy from further taxation.

The optimal level of non-resource tax is achieved where the marginal benefit and marginal cost curves meet at point 'a'. This corresponds with total non-resource tax level marked 'A'. The gains from non-resource tax effort is maximized in this economy at point 'A', in the absence of natural resources. With the discovery and extraction of minerals in this economy (assuming away a concurrent availability of hydrocarbon resources), the marginal benefit curve shifts upward and outward to the right, from MB_0 to MB_{MR} . The social planner now chooses a level of tax exemptions and discretionary application of tax laws that maximizes the net benefits from revenues associated with the new mineral resource sector. At point 'b', the new marginal benefit curve intersects with the marginal cost curve to reach a new equilibrium where total revenues increase as a result of the addition of mineral rents.

Due to the diffused nature of mineral resources and hence the constrained amount of rents accruing to the social planner, the choice of tax exemptions is no higher than point B. Point C, however, reflects a scenario associated with the extraction of hydrocarbon resources (assuming away availability of minerals and metals). These are relatively less appropriable. Total rents accrue to the social planner and the elite few, who also own the capital. The discovery and

exploitation of hydrocarbons, therefore, depict an outward shift in the marginal benefit curve from MBo to MB_{HR} . At point 'c', the marginal benefit and cost curves meet. The point coincides with a higher level of revenue erosion (for example tax exemptions) at C. Note that the social planner chooses that level of exemptions to maximize net benefits from hydrocarbon resources. Thus, with the hydrocarbon sector offering higher returns (net benefit ratio) than the minerals sector, the substitution effect in the case of the former is stronger. The social planner is likely to depend more on resource revenues from the sector rather than devoting effort to increasing non-resource tax revenues. In other words, a social planner endowed with minerals is more likely to devote effort to non-resource revenue mobilization outside the resource sector. This is reflected in a higher non-resource revenue level and lower level of tax exemptions offered. We examine the possibilities of these theoretical arguments within an empirical framework. In effect, we test the hypothesis that hydrocarbon-rich countries perform worse in non-resource tax effort than mineral-rich countries.

4.3 Empirical Framework

Evidence from the literature suggest that different types of natural resources have different impacts on development outcomes (Klosek, 2018; Boschini, Pettersson, & Roine, 2013; Fosu, 2013; El Anshasy & Katsaiti, 2013). As Boschini et al. (2013) note, “... *resources are, for example, not homogenous in terms of capital (labor) intensity, they are not comparable in terms of technological requirements for their extraction or production, nor are they equally “suitable” for rent-seekers and corrupt politicians, etc.*” (Boschini, Pettersson, & Roine, 2013, page 30). Some studies further indicate that hydrocarbons have a more adverse impact on economies compared to other natural resources (for instance, Knack, 2009; Karl, 1997). In line with our theoretical framework, we investigate empirically, whether there exists a differential impact of types of natural resources on non-resource tax effort.

We adopt panel econometric methods and employ alternative data sources. We explore a dummy variable approach that enables the use of interaction terms. We create a dummy to distinguish between hydrocarbon (oil and gas) producing countries and those with minerals (gold, diamond and other metals). We use data on mineral rents (includes gold, bauxite, silver, copper, zinc, etc.), oil rents and natural gas rents to guide this distinction. Our classification of hydrocarbon-producing countries is guided by Erbil, (2011), Bornhorst et al., (2009) and data from the United States Energy Information Administration. We also make use of the World Mining Data Report (Reichl, Schatz, & Zsak, 2017) to validate the list of mineral-producing countries. A key advantage of the dummy variable approach is the opportunity to use the full complement of data available.

4.3.1 Model Specification

To examine the differential impact of different types of resources on non-resource tax effort, we specify two baseline models to fit the two main datasets that we use. In the first specification (see equation 1 below), non-resource tax revenue as a percentage of GDP for country ‘i’ in time ‘t’ $\left(\frac{NRT}{Y}\right)_{it}$ is regressed on mineral rents as a percentage of GDP $\left(\frac{MR}{Y}\right)_{it}$ as well as hydrocarbon rents as a percentage of GDP for country ‘i’ at time ‘t’ $\left(\frac{HYDR}{Y}\right)_{it}$. The latter combines oil rents with rents from natural gas. We maintain the full list of control variables $(controls)_{it}$ as used in earlier chapters: GDP per capita, control of corruption, agriculture value-added as a percentage of GDP, trade openness as a percentage of GDP and grants as a percentage of GDP. Thus the first specification is given by equation 1:

$$\left(\frac{NRT}{Y}\right)_{it} = \beta_0 + \beta_1 \left(\frac{MR}{Y}\right)_{it} + \beta_2 \left(\frac{HYDR}{Y}\right)_{it} + \omega'(\text{controls})_{it} + \varphi_i + \tau_t + u_{it} \quad (1)$$

With φ_i and τ_t as the specific country effect and time effect respectively. u_{it} represents the error term for the panel. This specification allows to relax the theoretical assumption that countries are limited to either production of hydrocarbons or minerals only. The data suggests that even when countries dominate in the production of one type of resource, the other could be available even if production is in small quantities.

Our second specification allows us distinguish between hydrocarbon producing countries and mineral-producing countries, using the ICTD-GRD resource revenue database. In order to take advantage of the full dataset, we split it with a dummy variable to distinguish between hydrocarbon-rich countries and mineral-rich countries (ore and metals). There are concerns with making this distinction. First, not all countries in the sample begin extraction at the same time. This has consequences for revenue flows and hence the data available. Some countries start from a “zero” resource revenue level until they begin extraction later in the sample period. To address this, countries with very limited data either due to late start of extraction or administrative challenges with data collection are automatically dropped out of the regression estimates.

In addition, there might be the concern that countries that begin as major producers of one type of resource may end up getting more from the other resources over the sample period. In other words, the contribution of one resource category might change over the sample period. Such

instances are rare⁵¹, however, to the extent that they occur, we classify them on the basis of the resource type that has been produced over a longer duration and with more consistent revenue estimates. In the case of Ghana, for example, mineral production has outlasted the new hydrocarbon sector. Ghana is therefore classified as a mineral-producing country. Where both types of resources occur in a country, we rely on the United States Energy Information Administration's ranking of hydrocarbon-producing countries over the sample period. The ranking is based on hydrocarbon production levels per day for all major hydrocarbon-producing countries. We also refer to the World Mining Data report (Reichl et al., 2017), which forms the basis for categorizing countries as mineral producers or otherwise.

This assessment is complemented by comparing data on mineral rents as a percentage of GDP (includes gold, bauxite, silver, copper, zinc, etc.) with those on oil rents as a percentage of GDP plus natural gas rents as a percentage of GDP⁵². Countries that consistently receive higher rents from a type of resource over the sample period are designated as producers of that resource. The resulting categories are supported by and consistent with earlier studies (Knebelmann, 2017; Crivelli & Gupta, 2014; Thomas & Trevino, 2013; Ossowski & Gonzales, 2012; Erbil, 2011; Bornhorst et al., 2009).

The second base model specification to fit the data is given by equation 2:

$$\left(\frac{NRT}{Y}\right)_{it} = \beta_0 + \beta_1 \left(\frac{RR}{Y}\right)_{it} + \beta_2 \left(\frac{RR}{Y}\right)_{it} * Oilctry_{it} + \beta_3 Oilctry_{it} + \omega' (controls)_{it} + \phi_i + \tau_t + u_{it} \quad (2)$$

⁵¹ According to Caselli & Tesei, (2016), within-country principal natural resource export commodity production shares have rarely changed over time. This situation is even more pronounced in developing country contexts.

⁵² Available in World Development Indicators database

Where $\left(\frac{NRT}{Y}\right)_{it}$ is non-resource tax as a percentage of GDP for country 'i' at time 't'. $\left(\frac{RR}{Y}\right)_{it}$

is resource revenue as a percentage of GDP for country 'i' at time 't'. We introduce the dummy variable $Oilctry_{it}$ which assumes a value of 1 if resource revenues in country 'i' at time 't' comes mainly from hydrocarbon resources. The dummy variable is zero if resource revenues in country 'i' at time 't' are mainly generated from non-hydrocarbon resources (that is metallic and non-metallic minerals). We expect the coefficient of the resource revenue variable to be negative, just as the coefficient of the oil country dummy to signify the negative correlation between natural resources and tax effort.

4.3.2 Econometric Methods

We systematically build on our use of panel data techniques, guided by the econometric literature, while addressing weaknesses with each specified model. We explore the data with the aid of a scatter diagram and show a bivariate relationship between type of resource revenues/rents and non-resource tax effort.

The chapter also explores a range of estimators from Ordinary Least Squares (OLS), Fixed-effects to Generalized Method of Moment Estimators⁵³. Notwithstanding the use of OLS Pooled estimators as a starting point, we test for its appropriateness as a best fit, just as we do for alternative estimators. Through these tests and in addition to robustness checks, we indicate our preferred specifications. For instance, a Breuch-Pagan test enables us to make a choice between an OLS Pooled estimator and a Random-effects Estimator. Furthermore, a Hausman test helps us to conclude whether a systematic difference exists between a Random-effects

⁵³ Our interest in GMM is to explore a dynamic relationship between our variables of interest while addressing endogeneity of other variables within the model.

Estimators and a Fixed-effects Estimator. In addition to accounting for endogeneity, the use of a GMM estimator allows for persistence in the outcome variable of interest in the event of a shock. These estimators are also applied to sub-samples of the data to examine the extent to which context matters. We focus on developing countries as well as Lower-middle-income and Low-income Countries based on the World Bank income classification for such regions. Developing countries are generally more dependent on natural resources than developed countries.

In line with the specification in equation 2 above, we employ resource revenue data as an alternative data source. We also use an alternative econometric technique as a robustness check. Given that we use a dummy-variable approach, equation 2 is estimated using a Hausman-Taylor estimator. We include a hydrocarbon-producing country dummy as well as regional dummies, to account for idiosyncratic regional effects that are time-invariant. For the baseline model, in particular, we include two dummy variables and an interaction term to examine the differential impact of hydrocarbon and mineral revenues on non-resource tax effort. The model specification interacts resource revenues as a percentage of GDP with the oil country dummy. This makes it possible to examine the marginal effect of being an oil-producing country on non-resource tax effort, holding other factors constant.

Following Leite and Weidmann (1999), we define a regional dummy for Sub Saharan Africa (SSA) to capture time-invariant exogenous regional effects. The SSA dummy also partly resolves concerns with data from the region as well as its lingering structural challenges with domestic revenue mobilization.⁵⁴ In using a Hausman-Taylor estimator, we exploit all the

The relevance of the SSA dummy as an appropriate control may be weakened with an alternative argument about, for example, improvements in the quality of data in recent times. Nonetheless, the plausibility of the existence of regional-specific unobserved variables that might be correlated with the explanatory and explained variables makes the dummy variable still relevant.

benefits of using a fixed-effects estimator, including the advantage of retaining time-invariant variables (Green, 2003). The latter would have been dropped in a typical Fixed-effects estimator. Given that the specified model has both time-varying and time-invariant variables which are uncorrelated with the country effects, we are able to obtain consistent and efficient estimates of the coefficients of interest (Hausman & Taylor, 1981). The Hausman Taylor estimator makes it possible to instrument for both time-varying and time-invariant variables that are endogenous in the model. We define the endogenous variables as hydrocarbon country dummy (time-invariant), the interaction term between resource revenues and the hydrocarbon country dummy, and corruption (time-variant). Countries that perform poorly in non-resource tax revenue mobilization are more likely to rely on maximizing revenues from a newly discovered natural resource. Furthermore, countries with a weak tax system are less likely to have accountable institutions. Cases of corruption are therefore more likely, whether real or perceived. These factors inform our definition of endogenous variables. The exogenous variables are the SSA dummy (time-invariant) and the rest of the set of explanatory variables.

Finally, we examine the effects estimated for contexts we describe as local. These include developing countries as well as Lower-middle-income and Low-income Countries. We obtain and plot marginal effects for each specification with the aid of a bar graph.

4.3.3 Data and Descriptive Statistics

In order to explore our research question on the differential impact of type of natural resources on non-resource tax effort, we employ the ICTD GRD database along with the World Bank's World Development Indicators (WDI) database. Our main explanatory variables for the first specification – mineral rents as a percentage of GDP and hydrocarbon rents as a percentage of GDP - come from the WDI. Rents from each resource type is calculated by finding the

difference between the unit world price and the average unit cost of each resource and multiplying it by the total amount produced for each period, usually a year. Mineral rents are made up of rents from natural resource types including tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate while hydrocarbon rents are made up of rents from oil and gas production. In alternative specifications, we complement the rent data with resource revenue data from ICTD GRD. The summary statistics are provided in Table 32.

Table 32: Summary Statistics: Differential Impact of Type of Resources on Non-Resource Tax Effort

Variable	(1) count	(2) mean	(3) sd	(4) min	(5) max
tot_nrestax	1603	15.720	7.012	0.607	37.577
grants	1603	0.721	1.602	0.000	22.206
Corrupt control	1603	2.833	1.209	0.000	6.000
agricval2GDP	1603	12.341	10.090	0.035	57.239
Log GDP per capita	1603	8.413	1.329	5.122	11.618
trade2GDP2	1603	89.575	60.731	0.274	439.657
polity2*	1481	3.870	6.148	-10.000	10.000
minrent2gdp	1603	1.209	3.224	0.000	29.825
ngas2gdp	1603	0.318	0.753	0.000	6.236
oil_r2gdp	1603	4.013	9.459	0.000	60.452
hydrocr2gdp	1603	4.331	9.706	0.000	60.834
tot_resrev (mineral_ctries)*	405	2.597	5.706	0.000	30.014
tot_resrev (oil_ctries)*	664	7.419	11.212	0.000	65.569

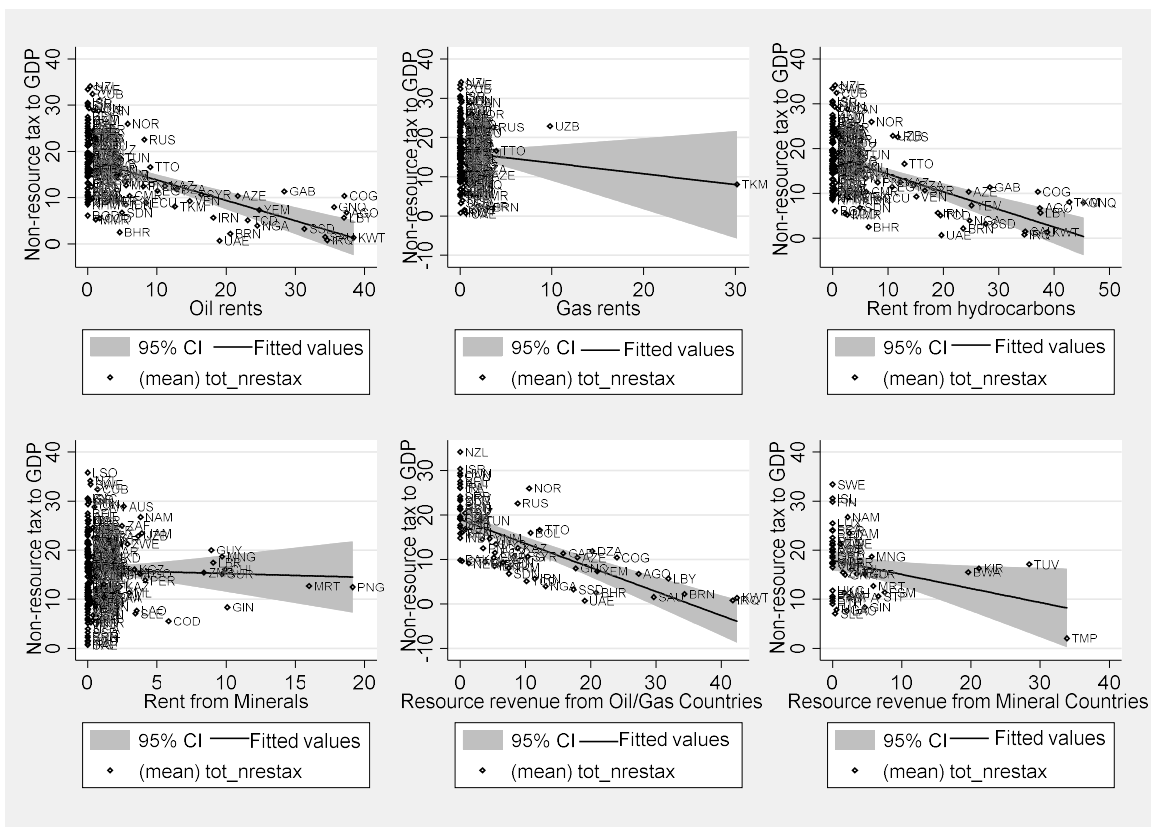
*Variables included for purposes of robustness checks

There are a total of 1,603 country-year observations for rents data as well as the list of control variables. Mineral rents as a percentage of GDP ranges from 0 to approximately 30 percent with a mean and standard deviation of 1.2 percent and 3.2 percentage points respectively. Hydrocarbon rents range from 0 to approximately 61 percent of GDP, recording a sample mean of 4.3 percent and a standard deviation of 9.7 percentage points. A total of 1,069 country-year observations exist for the resource revenue data in the ICTD GRD database. This comprises 405 observations for mineral-producing countries and 664 observations for hydrocarbon-

producing countries. The levels of resource revenues range from 0 to 30 percent for mineral-producing countries and 0 to 66 percent for hydrocarbon-producing countries. The average resource revenue as a percentage of GDP for the two sets of countries are approximately 3 percent and 7 percent respectively. Values for standard deviation are 6 percent and 11 percent respectively.

4.4 Empirical Results and Discussion

Figure 8: Scatter plot of hydrocarbon and minerals rents/revenue vs. Non-resource tax effort



Source: ICTD-GRD, 2017 & WDI, 2017

4.4.1 A Scatter Plot of relationships between type of resource rent/revenue and non-resource tax

In Figure 8, we present correlations between type of resource rent or revenue and non-resource tax effort. Overall, we see a negative relationship between type of resource rents (or revenues) and non-resource tax effort. Countries with higher levels of resource rents seem to devote less effort to mobilizing non-resource taxes. The relationship could also mean that countries that have difficulty in mobilizing non-resource taxes are more likely to depend on natural resource revenues/rents. There are however noticeable nuances. The linear relationship between hydrocarbons rents and non-resource tax effort is negative and more steeply sloped than the relationship between mineral rents and non-resource tax effort. As suggested in the theoretical discussion in section 4.2, the empirical relationship of a steeper slope for hydrocarbon rents suggests a greater substitution effect compared to case of mineral rents. Indeed, the slope relationship between mineral rents and non-resource tax effort is almost flat.

Moreover, once we employ data on resource revenues (rather than resource rents), we find a similar relationship. Countries with domestic revenues dominated by hydrocarbon resources tend to experience a greater substitution effect (steeper slope) compared to those with mineral revenues. In effect, oil and gas revenues tend to have a larger displacement effect on non-resource tax effort, compared to mineral revenues. This observation is, however, naïve as it does not account for several factors including the problem of omitted variable bias and a possibility of a non-linear relationship. We explore these relationships further in the next section with the appropriate panel econometric techniques.

4.4.2 Pooled OLS and Fixed-effects Estimators

The first two columns in Table 33 present OLS results with our full list of controls, including a dummy variable for Sub Saharan Africa. We test for the inclusion of country and time effects

progressively. The probability value of the F-test that the joint significance of time dummies is zero is zero, hence we reject the null hypothesis of no time effect. The Breusch-Pagan test for country heterogeneity also rejects the null hypothesis of no country fixed effect. Thus, country effects and time effects tend to be important in the model specification. This allows us to control for unobserved country invariant factors (including slow-changing socio-cultural factors) that might be correlated with the rents/revenues and non-resource tax effort. The time dummies should also control for global shocks that might affect non-resource tax effort. In column 1, we do not include country or time effects for purposes of establishing a baseline. In column 2, we include time dummies in response to the results of our test. Columns 3 and 4 present results from a Random-effects Estimator, in line with the Breusch-Pagan test. The fifth column shows estimates from a Fixed-effects model. A Hausman test does not reject the null hypothesis of no systematic difference between the Random-effects in column 4 and the Fixed-effects model in column 5. The results of the Hausman test yields a Chi-squared value of 28.99 with a probability value of 0.82. Since this probability value is far in excess of the conventional benchmark value of 0.05, we do not reject the null hypothesis.

Given the results of the Hausman test, the Random-effects Model with time effects in column 4, therefore, becomes our model of preference. The result in column 4 suggests that hydrocarbon rents exert an adverse impact on non-resource tax effort. The effect of mineral rents is however not statistically significantly different from zero. A percentage point increase in hydrocarbon rents displaces non-resource tax effort by about 0.13 percentage points. Across the five specifications, the coefficient on mineral rents as a percentage of GDP is not statistically significantly distinguishable from zero. The result remains qualitatively consistent

even with the inclusion of additional regional dummies.⁵⁵ Indeed, across all five specifications, hydrocarbon rents exert a negative and statistically significant effect on non-resource tax effort however this is not the case for mineral rents.

Table 33: Pooled OLS, Random-effects and Fixed-effects Specifications

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) OLS	(2) OLS	(3) REE	(4) REE	(5) FEE
minrent2gdp	0.0387 (0.0383)	-0.0413 (0.0420)	0.105 (0.0895)	0.0631 (0.0898)	0.0662 (0.0903)
hydrocr2gdp	-0.308*** (0.0142)	-0.295*** (0.0135)	-0.123*** (0.0308)	-0.130*** (0.0326)	-0.0953** (0.0411)
grants	0.0688 (0.0877)	-0.00535 (0.0848)	-0.0998 (0.154)	-0.0921 (0.144)	-0.0925 (0.151)
Corrupt control	1.368*** (0.157)	2.267*** (0.186)	0.312 (0.254)	0.595* (0.329)	0.537 (0.332)
agricval2GDP	-0.0390* (0.0225)	-0.0336 (0.0225)	-0.0322 (0.0592)	-0.0252 (0.0611)	-0.0213 (0.0642)
Log GDP per capita	2.046*** (0.220)	1.303*** (0.240)	2.874*** (0.758)	2.098*** (0.770)	2.257* (1.226)
trade2GDP2	-0.00945*** (0.00266)	-0.0105*** (0.00266)	0.00875 (0.0107)	0.00450 (0.0109)	0.00539 (0.0115)
SSA	3.668*** (0.355)	3.252*** (0.360)	3.115* (1.695)	2.034 (1.719)	
Country Effect	No	No	Yes	Yes	Yes
Time Effect	No	Yes	No	Yes	Yes
Observations	1,603	1,603	1,603	1,603	1,603
R-squared	0.451	0.495	0.28	0.34	0.3
Number of id	82	82	82	82	82

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This evidence of the differential impact of type of resource on non-resource tax effort compares favourably with those provided by Klomp & de Haan (2016) as well as Knack (2009), even if our outcome variable of interest is specific to non-resource taxes. In effect, the evidence of a fiscal resource curse weighs more heavily against hydrocarbon rents as compared to mineral

⁵⁵ We specify a model with five other regional dummies (East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, and South Asia), leaving North America out as a base reference. The results remain robust to the inclusion of additional regional dummies. Furthermore, a specification, which includes the type of political institution in place (polity2 variable) does not affect the main result either.

rents. Consistent with results in earlier chapters, control of corruption and GDP per capita are positively associated with non-resource tax effort. The coefficient of grants as a percentage of GDP is, however, not statistically significant. The OLS estimates in columns 1 and 2 show a negative association between trade and non-resource tax effort. Furthermore, the coefficient on the SSA dummy is positive and statistically significant, suggesting that non-resource tax effort is higher in SSA compared to the rest of the world. The main weakness of the OLS results in columns 1 and 2, relative to the fixed-effects estimators in columns 3 to 5, is in the fact that the former is undermined by omitted variables.

4.4.3 Robustness Checks with Alternative Estimators

The use of panel data allows us to explore dynamic relationships among our variables of interest. A shock to non-resource tax revenues would be persistent over time. Moreover, persistently low levels of non-resource revenues may provide incentives for focusing attention on maximizing rents from natural resources. We account for these possibilities by employing a Generalized Methods of Moments (GMM) estimator.

Across all specifications in Table 34, the hypothesis of a no first-order autocorrelation is rejected at the 1 percent level. However, the test of a no second-order autocorrelation is not rejected, thus, justifying our specification of a year's lag in our dependent variable as an additional regressor.

Table 34: Generalized Method of Moments Estimator – Dynamic effect

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) Diff GMM	(2) Two-Step	(3) Two-step	(4) Two-step	(5) Two-step	(6) Two-step
L.tot_nrestax	0.505*** (0.102)	0.890*** (0.143)	0.826*** (0.116)	0.953*** (0.113)	0.879*** (0.105)	0.906*** (0.100)
minrent2gdp	-0.00131 (0.0486)	-0.00633 (0.0235)	-0.0142 (0.0276)	0.0994 (0.0733)	-0.0312 (0.118)	0.00421 (0.0953)
hydrocr2gdp	-0.105*** (0.0215)	-0.0379 (0.0367)	-0.0542* (0.0324)	0.0354 (0.0264)	0.0405 (0.0320)	0.0438 (0.0316)
grants	-0.0359 (0.0597)	0.0313 (0.0620)	0.0429 (0.0555)	0.0256 (0.0603)	0.0650 (0.0637)	-0.171 (0.215)
Corrupt control	0.211 (0.165)	-0.00112 (0.186)	0.267 (0.259)	0.0110 (0.184)	0.384 (0.263)	0.384 (0.250)
agricval2GDP	-0.0955 (0.0612)	0.00503 (0.0179)	-0.00283 (0.0190)	0.00918 (0.0193)	0.0113 (0.0234)	0.00519 (0.0239)
Log GDP per capita	1.463** (0.652)	0.328 (0.483)	0.234 (0.380)	0.228 (0.440)	0.139 (0.407)	-0.0998 (0.398)
trade2GDP2	0.0124** (0.00559)	-0.000369 (0.00314)	-0.00129 (0.00304)	0.000407 (0.00258)	-9.42e-05 (0.00290)	0.000999 (0.00278)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	No	No	Yes	No	Yes	Yes
AR(1) P-Values	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) P-Values	0.34	0.47	0.42	0.42	0.33	0.37
Hansen J (P-Values)	0.38	0.04	0.23	0.08	0.27	0.34
No. of Instruments	67	11	42	13	44	45
Observations	1,489	1,585	1,585	1,585	1,585	1,585
Number of id	80	81	81	81	81	81

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

In Table 34, we apply both Difference and Two-step System GMM estimators with alternative specifications of endogenous and exogenous variables. While the two estimators are equivalent, the latter is said to have better finite sample properties in the case of small samples (Roodman, 2009). Given that the samples we use are reasonably large, the concern about finite samples do not apply. In columns 1 to 3, we instrument for corruption as an endogenous variable, following Bornhorst et al (2009). The results confirm a negative offset of hydrocarbon rents on non-resource tax effort. Once again, the effect of mineral rents is not statistically distinguishable from zero. The coefficient on hydrocarbon rents is however not statistically

significant in the second column, where the Hansen J test of the validity of instruments is also weak. The magnitude of the offset is however lower compared to results from the Fixed-effects Estimators in Table 33. In the fourth to sixth columns, we augment the list of endogenous variables with both hydrocarbon rents and mineral rents. In essence, these specifications depart from the assumption in Isham et al, (2005) that the choice between hydrocarbon rents and mineral rents are exogenous and mainly based on the endowment of these resources in an economy.

In column 6, we further add the grants variable to the list of endogenous variables. In doing so, none of the resource rent variables turn statistically significant. Column 4 also shows a weakened Hansen J test with a p-value of 0.08, following the inclusion of additional endogenous variables. Despite being statistically significant only at the ten percent level, our most preferred specification in column 3 attests to an adverse effect of hydrocarbon rents while the effect of mineral rents remains muted. The size of the effect of hydrocarbon rents is also reduced. A percentage point increase in hydrocarbon rents diminishes non-resource tax effort by about 0.05 percentage points, holding other factors equal. Although the coefficient on mineral rents alternate in sign across all six specifications, it is never statistically significant at conventional levels. This suggests that there is no statistically significant evidence of a displacement effect of minerals on non-resource tax effort.

4.4.4 From Global to Local Evidence: Type of Resource Rent and Non-Resource Tax Effort

In Table 35, we re-examine the evidence for countries in the data that make up the World Bank's classification of Low income and Lower-middle-income countries (LMICs). The specifications in Table 35 include our most preferred in columns 1 and 3. Both specifications address endogeneity concerns and are robust to heteroscedasticity. Column 1 depicts estimates

from a random-effects model with time effects and the full list of controls. The estimates suggest that hydrocarbon rents exert an adverse effect on non-resource tax effort whereas we do not find such evidence for mineral rents. The effect of the former is statistically significant at conventional levels. In column 2, the differential impact is indistinguishable given that none of the coefficients on the rent variables are precisely estimated. The Two-step GMM estimates in column 3 confirm the negative offset for hydrocarbon rents relative to mineral rents. In columns 4 and 5, these effects are less precisely estimated with the inclusion of additional variables that we specify as endogenous. The validity of instruments is also weakened as shown in the Hansen J p-value of 0.06 in column 5.

Table 35: Fixed-effects and GMM – LICs and LMICs

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) REE	(2) FEE	(3) Two-step	(4) Two-step	(5) Two-step
L.tot_nrestax			0.893*** (0.104)	0.902*** (0.0800)	0.908*** (0.0942)
minrent2gdp	-0.0129 (0.0813)	-0.000530 (0.0879)	-0.0184 (0.0275)	0.0285 (0.0676)	0.0968 (0.0940)
hydrocr2gdp	-0.136*** (0.0510)	-0.0980 (0.0677)	-0.0444* (0.0240)	-0.0145 (0.0363)	-0.0326 (0.0520)
grants	0.191* (0.103)	0.156 (0.124)	0.0252 (0.0355)	0.00273 (0.0470)	-0.313 (0.366)
Corrupt control	0.738 (0.513)	0.647 (0.480)	0.178 (0.215)	0.281 (0.196)	0.254 (0.287)
agricval2GDP	0.0303 (0.0751)	0.0561 (0.0863)	0.000184 (0.0180)	-0.00141 (0.0203)	-0.0331 (0.0328)
Log GDP per capita	3.244*** (0.956)	4.491*** (1.450)	0.150 (0.208)	0.0355 (0.191)	-0.658 (0.865)
trade2GDP2	0.0537** (0.0218)	0.0527** (0.0233)	0.0115* (0.00566)	0.00876 (0.00672)	0.00703 (0.00984)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	No	No	No
AR(1) P-Values	-	-	0.01	0.01	0.02
AR(2) P-Values	-	-	0.96	0.62	0.56
Hansen J (P-Values)			0.14	0.11	0.06
Observations	599	599	590	590	590
R-squared		0.333			
Number of id	32	32	31	31	31

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Column 4 includes mineral rents and oil rents as list of endogenous variables. Column 5 add grants to list of endogenous variables included in column 4.

Columns 3 through 5 exclude time dummies to avert the problem of instrument proliferation.

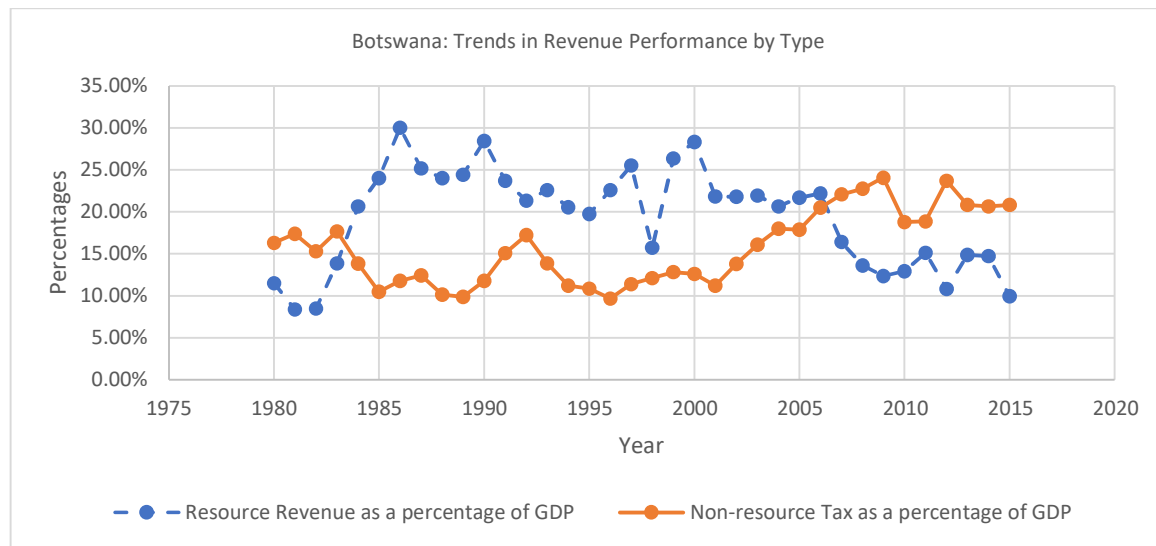
The effect sizes estimated in columns 1 and 3 compare favourably with those of the full sample, lending credence to the evidence of a differential impact between hydrocarbon rents and mineral rents on non-resource tax effort. The coefficient on trade turns out to be statistically significant and positively associated with non-resource tax effort in LMICs, as shown in columns 1 through 3. Similarly, GDP per capita, turns statistically significant in columns 1 and 2, indicating its positive association with non-resource tax effort. The evidence that mineral rents do less harm compared to hydrocarbon rents is further supported by Mamo et al., (2019), who found that new mineral discoveries or expansion in mineral extraction in Africa have contributed to the development of the sub-national structures (districts), where these activities take place. Their enclave nature, however, suggests that there are no spillover effects.

7.5.4.1 Robustness checks with alternative data: The case of 4 countries

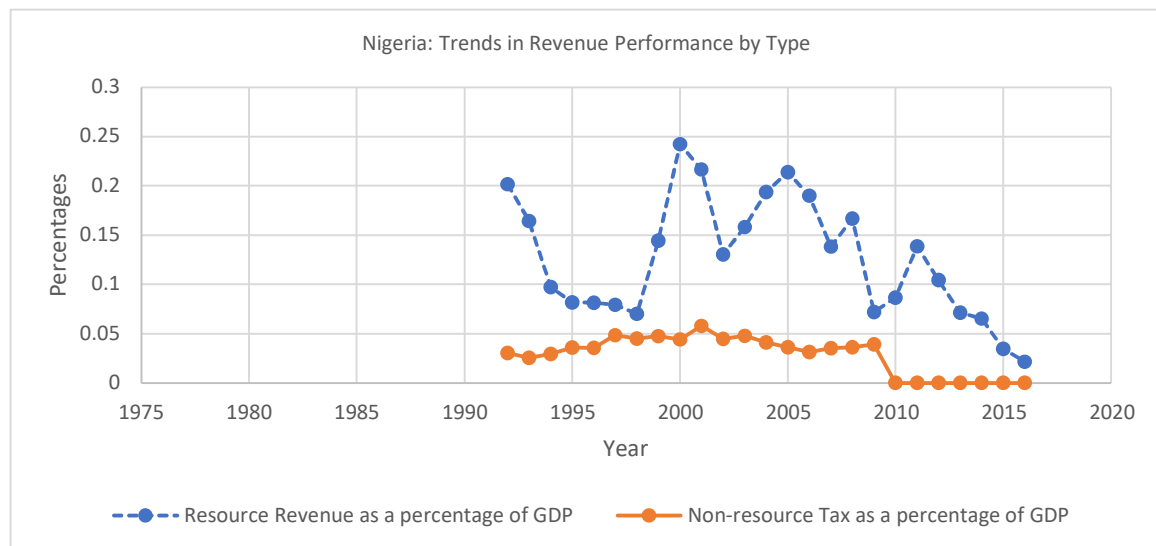
To further examine the robustness of our results, we employ the ICTD-GRD data on resource revenues. The latter dataset emphasizes the role of effective tax policy and tax administration as compared to our earlier measure – resource rents. While earlier chapters have already explored the relationship between resource revenues and non-resource tax effort, we examine the differential impact of revenues originating from different types of natural resources. First, we explore the case of four countries. Botswana and Chile are known for ore and metal extraction while Nigeria and Saudi Arabia are large producers of hydrocarbon resources. The four line graphs in Figure 9 show the relationship between resource revenues and non-resource tax effort in the selected countries. A casual observation of the trends in non-resource tax effort amongst the two hydrocarbon producers shows a less volatile trend compared to the mineral producers. For the hydrocarbon-producing countries, the trend signals ‘stability’ in policy

action over time resulting in very low or declining levels of non-resource tax revenues over time. Botswana and Chile, however, exhibit a non-monotonic increase in non-resource tax effort, signifying a less offset for non-resource taxes over time, when compared to the trend for Nigeria and Saudi Arabia.

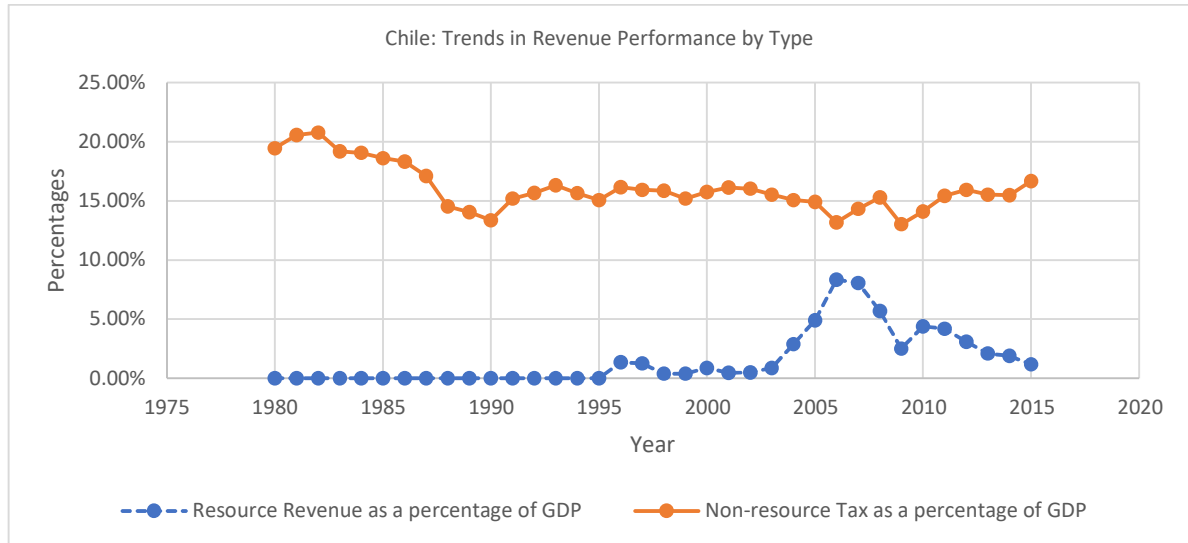
Figure 9: Trends in Revenue Performance: Four Countries Compared
(a)



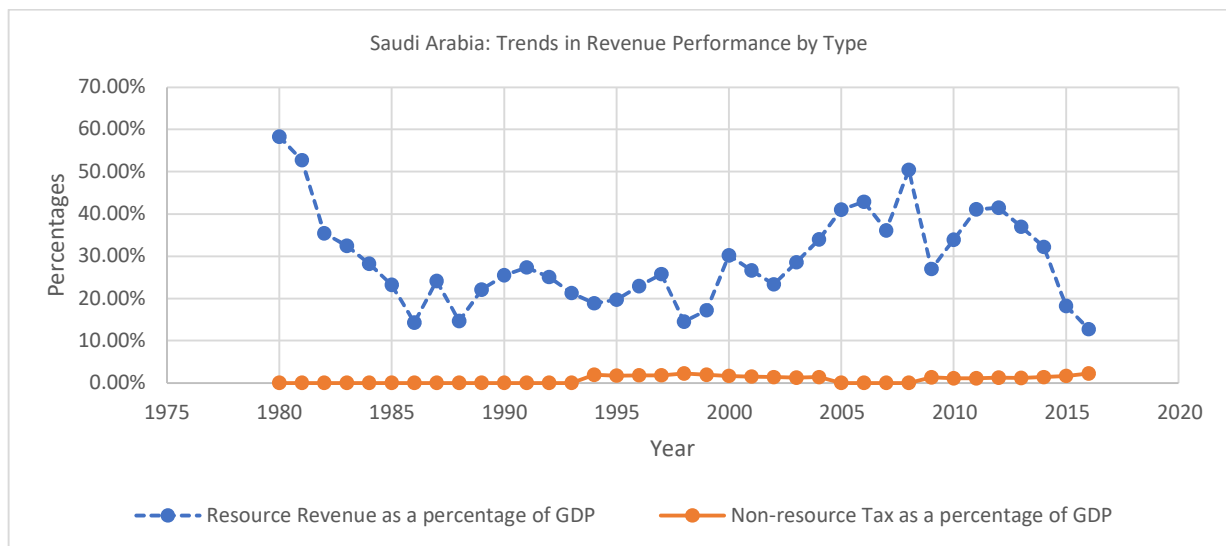
(b)



(c)



(d)



Source: ICTD-GRD, 2018

These trends, however, provide a limited understanding of the relationship between resource revenues and non-resource taxes since they omit several important factors that are also

correlated with the two variables. We explore these factors in the next section, where we distinguish between hydrocarbon resource-producing countries and mineral resource-producing countries by the use of a dummy.

7.5.4.2 Robustness checks with alternative data and estimation techniques

In Table 36, columns 1 and 2 show results from a Random-effects Model (REE), without and with time effects respectively. Given that a REE allows for time-invariant variables, we are able to estimate the marginal effects of being an oil country (compared to being a mineral-producing country) on non-resource tax effort. In columns 3 through 5, we specify a variety of models using the Hausman-Taylor estimator and controlling for time effects. Column 3 specifies three variables as endogenous: the interaction between resource revenues as a percentage of GDP and the oil country dummy, the oil country dummy and corruption. Column 4 adds to the list of endogenous variables by including total resource revenues. Column 5 then makes a final addition of grants to the aforementioned list of endogenous variables.

Table 36: Random-effects and Hausman-Taylor Estimators - Full Sample

Dependent variable: Non-resource tax as a percentage of Gross Domestic Product ⁵⁶					
VARIABLES	(1) REE	(2) REE	(3) H-T	(4) H-T	(5) H-T
Tot_resrev	-0.447*** (0.125)	-0.439*** (0.105)	-0.453*** (0.112)	-0.452*** (0.112)	-0.452*** (0.113)
Tot_resrev#oilctry	0.303** (0.131)	0.283** (0.116)	0.319** (0.125)	0.322** (0.126)	0.323** (0.126)
Oil_ctry	-4.095** (1.701)	-3.946** (1.607)	-5.199** (2.240)	-4.558** (2.278)	-4.457* (2.303)
Grants	0.0397 (0.106)	-0.00195 (0.0932)	0.00552 (0.0935)	0.00592 (0.0935)	0.00483 (0.0938)
Corrupt control	0.230 (0.267)	0.621 (0.386)	0.579 (0.395)	0.579 (0.395)	0.578 (0.396)

⁵⁶ We further test the robustness of our results with the inclusion of five other regional dummies representing East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, and South Asia, with North America dummy and the base reference. Our main results remain qualitatively consistent. None of the regional dummies turn statistically significant except the dummy for Europe and Central Asia which also turns positive as expected. Countries in the OECD area generally perform better with non-resource tax effort than other regions.

Agricval2GDP	-0.0122 (0.0686)	-0.0150 (0.0695)	-0.000770 (0.0750)	0.00126 (0.0754)	0.00153 (0.0755)
Log GDP per capita	2.654*** (0.774)	1.764** (0.808)	1.969* (1.027)	1.989* (1.052)	1.990* (1.057)
Trade2GDP2	0.00897 (0.0104)	0.00436 (0.0108)	0.00559 (0.0116)	0.00576 (0.0117)	0.00581 (0.0117)
SSA	1.380 (2.336)	-0.156 (1.916)	-0.184 (2.507)	-0.0569 (2.552)	0.0163 (2.572)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	No	Yes	Yes	Yes	Yes
Observations	1,069	1,069	1,069	1,069	1,069
Number of id	66	66	66	66	66

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The coefficients on total resource revenues, the oil country dummy, as well as the interaction term between these two variables all, turn statistically significant at conventional levels across all five specifications. The sign on the interaction terms however turns positive while the coefficient on total resource revenues and the oil country dummy are negative across all specifications. The latter provides an indication of a negative offset in non-resource taxes for hydrocarbon-producing countries compared to mineral-producing countries. The coefficient on the logarithm of income per capita also turns positive and statistically significant across all specifications. This is not the case for rest of the control variables: grants, trade, control of corruption and a dummy for Sub-Saharan Africa, which are not statistically significant at conventional levels.

If we define our base model for Table 36 as:

$$\left(\frac{NRT}{Y}\right)_{it} = \beta_0 + \beta_1 \left(\frac{RR}{Y}\right)_{it} + \beta_2 \left(\frac{RR}{Y}\right)_{it} * Oilctry_{it} + \beta_3 Oilctry_{it} + \omega' (controls)_{it} + \varphi_i + \tau_t + u_{it}$$

(1)

The marginal effect of being a hydrocarbon-producing country on non-resource tax effort would be given by⁵⁷:

$$\frac{\partial(NRT/Y)_{it}}{\partial(Oilctry)_{it}} = \beta_3 + \beta_2\left(\frac{RR}{Y}\right)_{it} \quad (2)$$

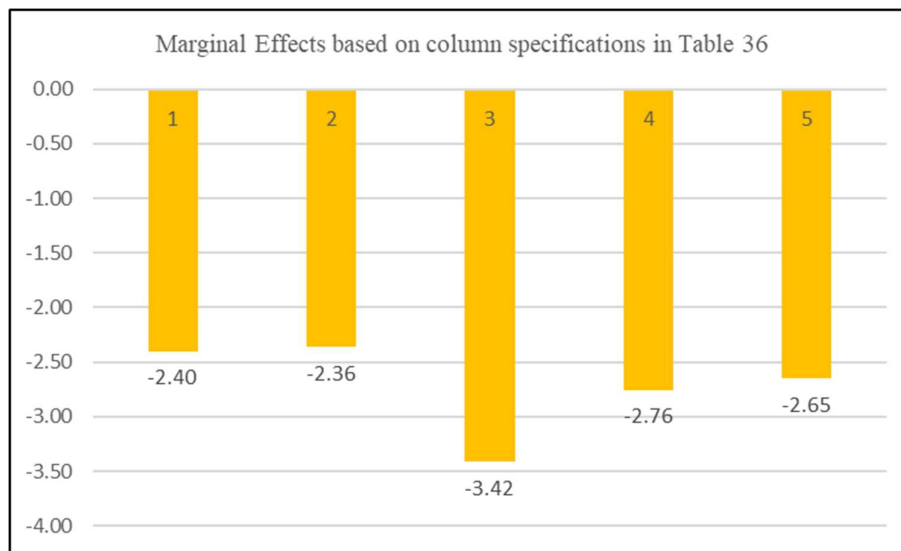
Using column one of table 36 as an example, we substitute the values of the coefficients into equation (2), which then becomes:

$$\frac{\partial(NRT/Y)_{it}}{\partial(Oilctry)_{it}} = -4.095 + 0.303(RR/Y)_{it}$$

With average resource revenues as a percentage of GDP in the full sample of countries being 5.592, the marginal effect of being a hydrocarbon-producing country on non-resource tax effort is $-4.095 + 0.303(5.592) = -2.4$. Thus, at a mean level of resource revenues as a percentage of GDP, an oil-producing country experiences an offset in non-resource taxes of about 2.4 percentage points more than a mineral-producing country, holding other things equal. Figure 10 presents a bar graph of these marginal effect across all five specifications in Table 36. The column specifications from the third bar to the fifth bar suggest that the marginal effects are slightly increased to an offset of about 3 percentage points more for an oil-producing country compared to a mineral-producing country. This result further suggests that, for the global sample, designating grants and total resource revenues as endogenous variables or otherwise does not significantly change the baseline result.

Figure 10: Differential Impact of type of Resource Revenues on Non-resource Tax Effort: Full Sample

⁵⁷ Note that we are also able to estimate the marginal effect of resource revenue on non-resource tax effort, if a country is associated with hydrocarbon resources. We do not explore such specifications since our main focus is to compare hydrocarbon producing countries with mineral-producing countries.



Source: Author's construct, 2019

Based on equations (1) and (2), we determine if context matters in distinguishing between the marginal effect on non-resource taxes for hydrocarbon-producing countries compared to mineral-producing countries. First, we look at the marginal effect for the sample of developing countries in our data, after which we explore similar estimations for LICs and LMICs.

Table 37 presents results for the Random-effects Estimator with time effects (column 1) and the Hausman-Taylor estimator (columns 2 through 5) for the subsample of developing countries. In column 2, we specify the interaction term, the dummy variable for hydrocarbon-producing countries and the corruption variables as endogenous and thus instrument for them. In column 3, we add grants to the list of endogenous variables. In column 4, we replace the grants variable with total resource revenues. In column 5, we restore the grant variable as endogenous, in addition to the interaction term, its constituting variables and corruption. The coefficient on total resource revenues, oil country dummy and the interaction term all turn out statistically significant at the one percent level. The magnitudes of the coefficients are larger for developing countries compared to the full sample, suggesting that the differential effect of

type of resource revenues on non-resource tax effort is more pronounced for developing countries. This is to be expected, given that developing countries depend more on natural resources compared to their advanced counterparts.

Table 37: Random-effects and Hausman-Taylor Estimators - Developing Countries' Sample

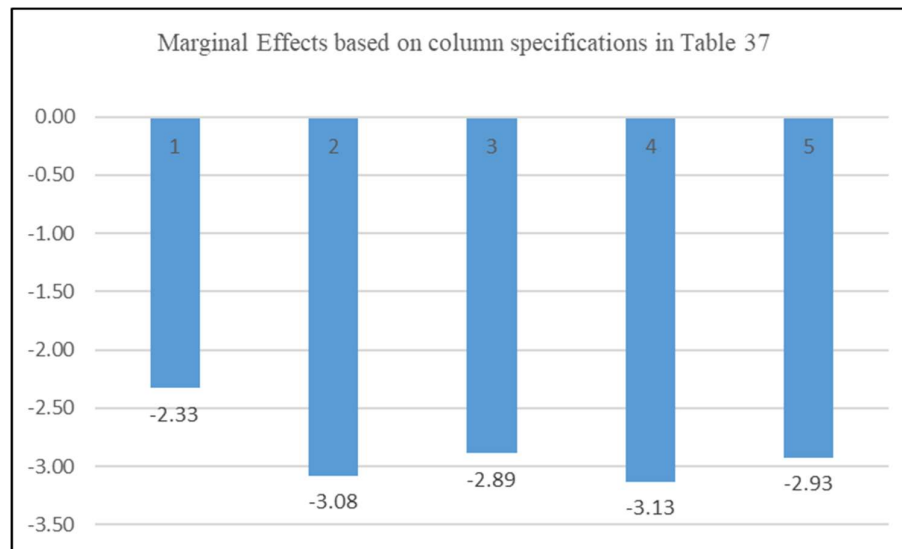
VARIABLES	(1) REE	(2) H-T	(3) H-T	(4) H-T	(5) H-T
tot_resrev	-0.525*** (0.0844)	-0.543*** (0.0856)	-0.544*** (0.0857)	-0.543*** (0.0862)	-0.544*** (0.0862)
tot_resrev#oilctry	0.393*** (0.0946)	0.441*** (0.0994)	0.442*** (0.0995)	0.439*** (0.0994)	0.441*** (0.0995)
oil_ctry1	-4.525*** (1.610)	-5.546*** (1.824)	-5.362*** (1.847)	-5.588*** (1.814)	-5.394*** (1.840)
Log GDP per capita	1.876* (1.069)	2.027 (1.670)	2.033 (1.670)	2.019 (1.627)	2.026 (1.635)
trade2GDP2	0.0162 (0.0112)	0.0146 (0.0114)	0.0146 (0.0114)	0.0146 (0.0113)	0.0146 (0.0113)
Corrupt control	0.498 (0.333)	0.499 (0.330)	0.497 (0.330)	0.499 (0.330)	0.497 (0.330)
SSA		-1.361 (2.113)	-1.257 (2.105)	-1.351 (2.076)	-1.251 (2.073)
Constant	2.877 (8.113)	2.289 (12.70)	2.103 (12.69)	2.413 (12.38)	2.201 (12.43)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	660	660	660	660	660
Number of id	45	45	45	45	45

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 11 shows the marginal effect of total resource revenues on total non-resource tax in hydrocarbon-producing countries compared to mineral-producing countries, for developing countries. The evidence suggests slightly more adverse effect on non-resource tax effort for oil-producing countries, compared to mineral-producing countries. The marginal effect is just about -2.33 using the Random-effects Estimator, 'increasing' just above -3.0 across the specifications with the Hausman-Taylor estimator. Apart from GDP per capita, which retains its statistically significant impact on non-resource tax effort in column 1, none of the other

covariates (trade, grants, corruption and an SSA dummy) is statistically significantly different from zero.

Figure 11: Marginal Effect of Hydrocarbon revenues relative to mineral revenues: Developing Countries sample



Source: Author's construct, 2019

In Table 38, we estimate the models similar to those specified in columns 1 through 5 of Table 37. However, the estimates are based on a subsample for LICs and LMICs. Most of the countries in this subsample fall within the Sub-Sahara African region. The coefficient on resource revenues is negative and remains statistically significant at the one percent level. The coefficient on the interaction term between resource revenues and the oil country dummy also remain statistically significant at conventional levels. The coefficient on the oil country dummy, however, assumes much larger standard errors and therefore does not turn out statistically significantly different from zero in any of the specifications. On average, the magnitude of the coefficient on *oilctry* is also least across all specifications when compared to both the developing country sample and the full sample. That notwithstanding, we are able to

apply equations (1) and (2) to estimate the marginal effect of resource revenues, taking into account the coefficients of the interactive term and the *oilctry* dummy.

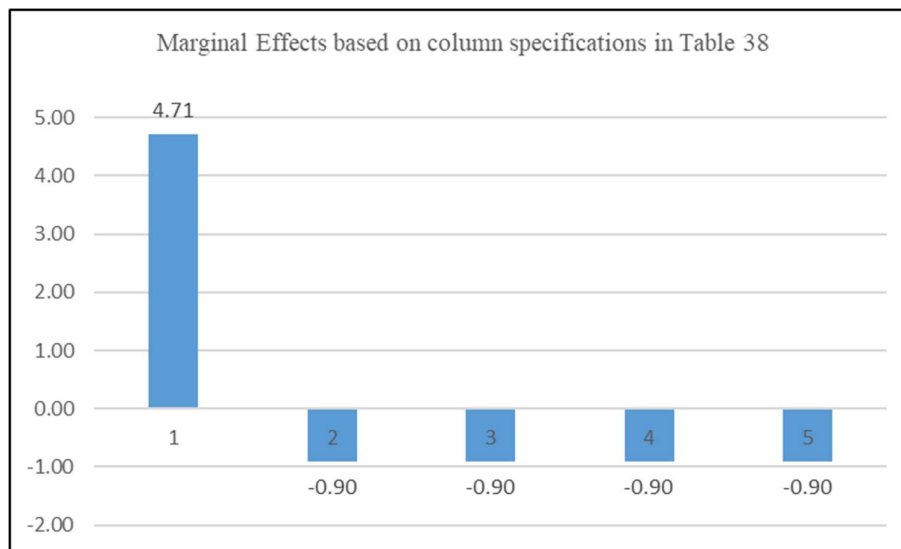
Table 38: Random-effects and Hausman-Taylor Estimators - Low-Middle-Income and Low-Income Countries' Sample

VARIABLES	(1)	(2)	(3)	(4)	(5)
<i>tot_resrev</i>	-1.315*** (0.254)	-0.748*** (0.281)	-0.748*** (0.281)	-0.748*** (0.281)	-0.748*** (0.281)
<i>tot_resrev#oilctry</i>	0.963*** (0.239)	0.616** (0.272)	0.616** (0.272)	0.615** (0.272)	0.615** (0.272)
<i>oil_ctry1</i>	-0.674 (1.286)	-4.344 (2.741)	-4.344 (2.741)	-4.337 (2.736)	-4.337 (2.736)
Log GDP per capita	-1.848 (1.129)	1.367 (2.512)	1.367 (2.512)	1.356 (2.504)	1.356 (2.504)
<i>trade2GDP2</i>	0.0662*** (0.0142)	0.0495** (0.0252)	0.0495** (0.0252)	0.0495** (0.0252)	0.0495** (0.0252)
Corrupt control	-0.584 (0.422)	0.00143 (0.352)	0.00143 (0.352)	0.00130 (0.352)	0.00129 (0.352)
SSA		-1.498 (1.679)	-1.498 (1.679)	-1.500 (1.677)	-1.500 (1.677)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	No	Yes	Yes	Yes	Yes
Observations	359	359	359	359	359
Number of id	26	26	26	26	26

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 12: Marginal Effect of Hydrocarbon revenues relative to mineral revenues: LMIC and LIC sample



Source: Author-generated, 2019

The marginal effects in Figure 12 further confirm our theory that hydrocarbon rents or revenues do have a more adverse impact on non-resource tax effort than mineral rents or revenues. The opposite effect identified in column one could be attributed to the omission of time effects in the model and thus confirms the importance of its inclusion in the model as done for specifications in table 36 and 37. With regards to the Hausman-Taylor estimator in columns 2 to 5, the offset is about 0.9 percentage points more for hydrocarbon-producing countries than mineral-producing countries. The reduced effect perhaps reflects the omission of large oil-exporting countries like Angola, Iran, Iraq, Libya, Equatorial Guinea, Trinidad and Tobago, Saudi Arabia, among others, who fall outside the World Bank's definition of LICs and LMICs sample of countries (see Appendix C). The trade variable turns out statistically significant across all specifications but mostly marginally so, at the ten percent level. This suggests a positive relationship between trade and non-resource tax in LICs and LMICs. Other covariates are mostly not statistically significant at conventional levels.

4.5 Chapter Summary

In this chapter, we examined the differential impact of two categories of natural resources, hydrocarbon resources and mineral resources, on non-resource tax effort. We presented a

simple theoretical framework regarding how different types of natural resources trigger different incentives for improving non-resource tax effort. Extraction of hydrocarbon resources are usually capital-intensive and concentrated within a confined geographical space. This means fewer people are engaged. Power is therefore concentrated in the hands of the elite few, which then translates to power to distribute rents in the form of generous tax incentives, tax exemptions but also limited investment in fiscal capacity. A direct implication is a reduced non-resource tax effort and therefore lower level of non-resource taxes. Mineral resources, on the other hand, are more diffused. Rents and therefore concentration of power is also likely to be more diffused. The incentives that face the incumbent elite towards distributing rents or buying support is also more limited. Non-resource tax effort is, therefore, more likely to be important, with implications for raising non-resource taxes.

An empirical examination of this theoretical view confirms a differential impact of the two categories of natural resources on non-resource tax effort. Hydrocarbon rents exert a deleterious impact on non-resource tax effort. The effect of mineral rents on non-resource tax effort is hardly statistically significant across different specifications. Using a Hausman-Taylor estimator, we find that the differential impact of resource revenues on non-resource tax effort is between negative 0.1 and 0.35 percent points more for hydrocarbon-producing countries than for mineral-producing countries.

CHAPTER FIVE

5.0 CONCLUSION AND POLICY IMPLICATIONS

5.1 Introduction

This dissertation contributes to the theoretical and empirical literature in furthering our understanding of the relationship among natural resources, institutions and domestic revenue mobilization. Three research questions are explored in examining variants of the fiscal resource curse phenomenon; the idea that associates natural resource wealth with poor tax revenue outcomes outside the natural resource sector. First, we evaluate the claim that countries that have non-renewable natural resources are unable to mobilize taxes from a broad and sustainable base. The study also examines whether the type and quality of institutions plays a mitigating role in the adverse effect of natural resource rents on non-resource tax effort. Finally, there is a distinction between two main types of non-renewable natural resources: hydrocarbons and minerals and how they differentially impact on non-resource tax effort. In each case, the study examines the extent to which different contexts, ranging from global to the case of developing countries, impacts on the relationships. Each research question is motivated by theoretical arguments, based on available literature, to provide a framework for exploring the relationships.

5.2 Summary of Major Findings

In the first empirical chapter, we adopt a novel instrumental variable strategy. The strategy takes account of China's increased role in the global natural resource trade after 2001 when the country joined the World Trade Organization. China's resource trade strategy includes resource-for-infrastructure deals which provides transport and energy infrastructure to resource-exporting countries in exchange for natural resources. Modelled as an exogenous shock, we examine how China's natural resource trade intermediates the relationship between

resource revenues and non-resource tax effort. We find that, once we account for the ‘China shock’, there is no consistent evidence of a negative effect of resource revenues on non-resource taxes. In some specifications, we find that the ‘China shock’ might have contributed positively to non-resource tax effort in developing countries. China’s investment in much-needed social and economic infrastructure might have contributed to an expansion of the non-resource sector, expanding the tax base and improving non-resource tax revenues. The evidence is however only statistically significant at the 10 percent level.

In the second empirical chapter, we present a theoretical model on how institutions mediate between the effect of natural resource rents on non-resource tax effort. A key insight from the model suggests that institutions that focus on redistribution only play a weak mitigating role on the negative impact of natural resource rents on non-resource tax effort. This is especially the case when commodity prices are high. Rather than focusing on any single type of institution, we empirically test, whether, 12 different measures of institutions commonly used in the literature play any mitigating role in the relationship. The empirical evidence suggests that institutions play a limited role. While constraints on the executive and the quality of democracy play a mitigating role in the adverse effect of natural resource rents on non-resource tax effort, these measures of institutions alone are unable to undo the fiscal resource curse. We find that improving the size of the economy, control of corruption and addressing the size of informality (proxied by the size of the agricultural sector) tend to be more important in improving non-resource tax revenues. The size of international trade is another critical element to consider in attempts to improve non-resource tax effort.

Finally, we find that different types of natural resources trigger different incentives for non-resource tax effort. We present a simple theoretical model regarding the differential impact of

different types of natural resources on non-resource tax effort. We demonstrate theoretically and empirically that countries dominated by hydrocarbon revenues are at a higher risk of a fiscal resource curse than those that depend on mineral resources.

5.3 Key Policy Implications

These findings have important policy implications for developing countries, in particular, LICs and LMICs. First, it suggests that natural resources need not be a curse. Translating natural resource endowment into improved fiscal capacity requires a deliberate strategy that gives recognition to both local and global factors. From the first empirical paper, the global factors would include taking advantage of resource trade arrangements that are beneficial for improving much-needed infrastructure, expanding the non-resource sector and diversifying the economy. The key lesson is that non-renewable natural resource would not always be there. They are exhaustible and could leave countries vulnerable if there are no sustainable alternatives for domestic revenue mobilization to finance development efforts.

Fast-changing technology in the era of the fourth industrial revolution means that many components of consumer products today could be replaced by safer and cheaper alternatives. In the case of hydrocarbons, the global agenda to reduce fossil fuel emissions would only intensify as evidenced by the global climate change agenda, as well as, targets proposed by the various state and non-state actors under the Paris Climate Change Accord. It would, therefore, be prudent for developing countries to use their current natural resource wealth to improve their domestic resource mobilization capabilities outside the natural resource sector. This step would reduce the potential trade-offs that have been witnessed in many countries such as Nigeria, Venezuela and Saudi Arabia.

The size of the informal economy and the level of corruption in many developing countries further suggest that securing democratic institutions and a highly competitive legislative assembly would be necessary but not a sufficient condition in addressing domestic revenue mobilization deficits. Interventions towards formalizing the economy would be important. These would include improving identity systems as well as individual and business registration systems. Reducing barriers to tax compliance, strengthening tax administration, including the adoption of technology, are a few examples of critical steps that would be required. Furthermore, effective preventive and punitive systems to deal with leakages and corruption can contribute to improving tax revenues.

While our findings confirm that incentives faced by oil-rich countries are significantly different from those faced by mineral-rich economies, oil-rich countries like the United Arab Emirates, Qatar and Bahrain have, in recent times, demonstrated that oil wealth need not translate into an oil curse (Fosu, 2013a). Deliberate strategies to diversify their economies into services, for example, depict a long-term strategy to expand the non-resource sector and therefore potentially increase the amount of non-resource taxes that can be collected now and, in the future, when the oil wells eventually dry up. In the case of Bahrain, the government's policy decision not to use oil wealth to fund recurrent expenditure but instead depend on non-oil revenues is an example of a direct incentive to improve non-resource tax outcomes. In its development plans, the government decided to meet recurrent expenditure with non-resource revenues (Hamdi & Sbia, 2013). It was an indirect attempt to build state capacity to mobilize non-resource taxes despite the fact that the global meltdown from 2007 to 2009 undermined these measures significantly.

5.4 Summary of Contribution to the Literature

Our contribution to the literature relate to the following. First, we take advantage of a new global dataset on government revenues to re-examine the relationship between resource revenues and non-resource tax effort. Data challenges has raised questions about previous evidence. We extend our scope beyond hydrocarbon-rich economies to include mineral-producing countries as well. We also cover a larger set of countries and a longer period compared to previous literature. We employ a novel econometric strategy that takes into consideration how global factors (i.e. China's increased role in global resource trade) influence domestic non-resource tax effort. We also examine different contexts, from global evidence to those of developing countries.

In assessing the role of different types of institutions on fiscal capacity in the presence of non-renewable resources we propose a theoretical model. We subject the predictions of the model to an empirical test. In doing so, we expand the list of institutional variables that have been previously analyzed used in the literature in order to get a more comprehensive view. This leads us to select 12 different measures of institutions that have been most commonly referred to in the literature but also have an extensive coverage across countries and over time. Our definition of fiscal capacity, non-resource tax effort, ensures that we focus on that part of the tax base that is broad and sustainable.

Our third empirical chapter also proposes a theoretical framework in examining the differential impact of different types of natural resource revenues on non-resource tax effort. We do this by extending the model developed by Knack (2009), which focuses on windfall revenues and tax systems. We extend the model by distinguishing between different types of windfall revenues from the non-renewable natural resource sector. We demonstrate, theoretically, how

different types of non-renewable natural resources impacts differently on non-resource tax effort, rather than tax systems in general. Our empirical strategy also provides more robust evidence given that we explore alternative data sources as well as an alternative econometric strategy that has not been previously used in understanding the relationship.

5.5 Limitations and Opportunity for Future Research

An important limitation to this work is the fact that the analysis is done at the macro-level with estimates aggregated across different countries and over time. This may obscure time-varying peculiar factors that may be at play within individual countries, which may affect non-resource tax effort. An opportunity exists for assessing how the research questions apply to individual countries. For example, how does this research apply to new hydrocarbon-producing countries like Ghana or Uganda? A country-level analysis will complement the output of this dissertation. Moreover, such an approach would generate specific insights peculiar to a country on how to improve non-resource tax effort in the presence of natural resources. A combination of a country-level quantitative analysis with qualitative approaches such as case studies would prove useful for future research. There is also opportunity to use this approach for comparative analysis. These would yield tailored policy recommendations for each country surveyed.

A question that arises from the third empirical chapter is the extent to which the “China” shock mediates the relationship between different types of natural resources and non-resource tax effort. For instance, do oil-exporting countries enjoy different resource-for-infrastructure deals compared to minerals-exporting countries? Thus, future research can explore the extent to which China’s resource-for-infrastructure deals vary by the type of natural resources exported by a country. This information should further enhance our understanding on whether the

differential impact of different types of natural resources on non-resource tax effort is mediated by the ‘China shock’.

Finally, given the importance of comprehensive revenue data, not just for the kind of analysis undertaken here, but also for tracking the SDG goal 17.1 on revenue mobilization, a global research project that coordinates data gathering efforts by international organizations would be valuable. This would reduce parallel efforts, promote efficiency, synergy and provide needed standards for data quality.

BIBLIOGRAPHY

- Abdulahi, M. E., Shu, Y., & Khan, M. A. (2019). Resource rents, economic growth, and the role of institutional quality: A panel threshold analysis. *Resources Policy*, 61(71673081), 293–303. <https://doi.org/10.1016/j.resourpol.2019.02.011>
- Abeberese, A. B. (2019). *The Effect of Electricity Shortages on Firm Investment : Evidence from Ghana*. 1–17. <https://doi.org/10.1093/jae/ejz013>
- Acemoglu, D., & Johnson, S. (2005). Unbundling Institutions. *Journal of Political Economy*, 113(5). <https://doi.org/10.2139/ssrn.442900>
- Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The Colonial Origins of Comparative Development: An Empirical Investigation. *American Economic Review*, 91(5), 1369–1401. <https://doi.org/10.1257/aer.91.5.1369>
- Acemoglu, D., Naidu, S., Restrepo, P., & Robinson, J. A. (2018). Democracy Does Cause Growth. *Journal of Political Economy*. <https://doi.org/10.2139/ssrn.2411791>
- Acemoglu, D., & Robinson, J. A. (2008). The role of institutions in development. *The World Bank Economic Review*, 3(suppl 1), 153–176.
- Acemoglu, D., Robinson, J. A., & Torvik, R. (2016). The Political Agenda Effect and State Centralization. *MIT Department of Economics Working Paper Series 16-04*.
- ADB Group. (2016). *African Economic Outlook 2016*. Retrieved from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AEO_2016_Report_Full_English.pdf
- Adkins, L. C., & Hill, C. R. (2011). *Using Stata for Principles of Econometrics, Fourth Edition* (Fourth). New York: John Wiley and Sons Inc.
- African Development Bank Group. (2018). African Economic Outlook. In *Annual yearly review study*. Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/African_Economi

c_Outlook_2018_-_EN.pdf

- Akpanjar, G., & Kitchens, C. (2017). From darkness to light: The effect of electrification in Ghana, 2000-2010. *Economic Development and Cultural Change*, 66(1), 31–54. <https://doi.org/10.1086/693707>
- Al Mamun, M., Sohag, K., & Hassan, M. K. (2017). Governance, resources and growth. *Economic Modelling*, 63, 238–261. <https://doi.org/10.1016/J.ECONMOD.2017.02.015>
- Alemayehu, G. (2018). The Emerging Pattern of African Economic Engagement with China and the Rising South: Implications for Africa’s Structural Transformation. *Journal of African Economies*, 27(suppl_1), i52–i90. <https://doi.org/10.1093/jae/ejy014>
- Alexeev, M., & Chernyavskiy, A. (2015). Taxation of natural resources and economic growth in Russia’s regions. *Economic Systems*, 39(2), 317–338. <https://doi.org/10.1016/j.ecosys.2014.10.007>
- Alexeev, M., & Conrad, R. (2009). The Elusive Curse of Oil. *Review of Economics and Statistics*, 91(3), 586–598. <https://doi.org/10.1162/rest.91.3.586>
- Allcott, H., Collard-Wexler, A., & O’Connell, S. D. (2016). How do electricity shortages affect industry? Evidence from India. *American Economic Review*, 106(3), 587–624. <https://doi.org/10.1257/aer.20140389>
- Allcott, H., & Keniston, D. (2018). Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. *Review of Economic Studies*, 85(2), 695–731. <https://doi.org/10.1093/restud/rdx042>
- Alsharif, N., & Bhattacharyya, S. (2016). *Oil Discovery, Political Institutions and Economic Diversification*. 271084(0).
- Amiri, H., Samadian, F., Yahoo, M., & Jamali, S. J. (2018). Natural resource abundance, institutional quality and manufacturing development: Evidence from resource-rich countries. *Resources Policy*, (November), 1–11.

<https://doi.org/10.1016/j.resourpol.2018.11.002>

Andersen, Jorgen Juel, & Aslaksen, S. (2013). Oil and political survival. *Journal of Development Economics*, 100(1). <https://doi.org/10.1016/j.jdeveco.2012.08.008>

Andersen, Jørgen Juel, & Aslaksen, S. (2008). Constitutions and the resource curse. *Journal of Development Economics*, 87(2), 227–246. <https://doi.org/10.1016/j.jdeveco.2007.12.005>

Ang, J. B. (2013). Institutions and the long-run impact of early development. *Journal of Development Economics*, 105(1), 1–18. <https://doi.org/10.1016/j.jdeveco.2013.06.002>

Angrist, J. D., & Pischke, J.-S. (2008). *Mostly Harmless Econometrics : An Empiricist ' s Companion*.

Angrist, J. D., & Pischke, J.-S. (2009). *A Note on Bias in Just Identified IV with Weak Instruments*. (c), 1–4.

Aoki, M. (2001). *Toward a comparative institutional analysis*. Retrieved from <https://mitpress.mit.edu/books/toward-comparative-institutional-analysis>

Arezki, R., & Gylfason, T. (2013). Resource rents, democracy, corruption and conflict: Evidence from Sub-Saharan Africa. *Journal of African Economies*, 22(4), 552–569. <https://doi.org/10.1093/jae/ejs036>

Arezki, R., Ramey, V. A., & Sheng, L. (2017). News shocks in open economies: Evidence from giant oil discoveries. *Quarterly Journal of Economics*, 132(1), 103–155. <https://doi.org/10.1093/qje/qjw030>

Arkadie, B. Van. (1990). The Role of Institutions in Development. *World Bank Economic Review*, 153–191.

Arndt, C., Jones, S., & Tarp, F. (2015). Assessing foreign aid's long-run contribution to growth and development. *World Development*, 69, 6–18. <https://doi.org/10.1016/j.worlddev.2013.12.016>

Arndt, C., Jones, S., & Tarp, F. (2016). What is the aggregate economic rate of return to foreign

- aid? *World Bank Economic Review*, 30(3), 446–474. <https://doi.org/10.1093/wber/lhv033>
- Aryeetey, E. (2004). Financing Africa’s Future Growth and Development: Some Innovations. *Institute of Statistical, Social and Economic Research, University of Ghana*.
- Asquith, B. J., & Rodriguez-lopez, A. (2017). *The US Job Growth and The China Shock* (No. 24080). Cambridge, MA.
- Atkinson, A. B. (2003). *Discussion Paper No . 2003 / 88 Innovative Sources for Development Finance : Over-Arching Issues*. 6–7.
- Autor, D. H., Dorn, D., & Hanson, G. H. (2016). The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade. *Annual Review of Economics*, 8(1), 205–240. <https://doi.org/10.1146/annurev-economics-080315-015041>
- Badeeb, R. A., Lean, H. H., & Clark, J. (2017). The evolution of the natural resource curse thesis: A critical literature survey. *Resources Policy*, 51(December 2016), 123–134. <https://doi.org/10.1016/j.resourpol.2016.10.015>
- Barandiarán, J. (2019). Lithium and development imaginaries in Chile, Argentina and Bolivia. *World Development*, 113, 381–391. <https://doi.org/10.1016/J.WORLDDEV.2018.09.019>
- Bates, R. H., Block, S. A., Fayad, G., & Hoeffler, A. (2012). The new institutionalism and Africa. *Journal of African Economies*, 22(4), 499–522. <https://doi.org/10.1093/jae/ejs031>
- Baum, A., Gupta, S., Kimani, E., & Tapsoba, S. J. (2017). Corruption, taxes and compliance. *EJournal of Tax Research*, 15(2), 190–216.
- Baunsgaard, T., & Keen, M. (2010). Tax revenue and (or ?) trade liberalization. *Journal of Public Economics*, 94(9–10), 563–577. <https://doi.org/10.1016/j.jpubeco.2009.11.007>
- Bawumia, M., & Halland, H. (2017). *WIDER Working Paper 2017 / 185 Oil discovery and macroeconomic management The recent Ghanaian experience Mahamudu Bawumia * and Håvard Halland +*.
- Benedek, D., Crivelli, E., Gupta, S., & Muthoora, P. (2014). Foreign Aid and Revenue: Still a

- Crowding-Out Effect? *FinanzArchiv: Public Finance Analysis*, 70(1), 67–96.
<https://doi.org/10.1628/001522114X679156>
- Berman, N., Couttenier, M., Rohner, D., & Thoenig, M. (2017). This Mine is Mine! How Minerals Fuel Conflicts in Africa. *American Economic Review*, 107(6), 1564–1610.
<https://doi.org/10.1257/aer.20150774>
- Besley, T., & Persson, T. (2009). The origins of state capacity: Property rights, taxation, and politics. *American Economic Review*, 99(4), 1218–1244.
<https://doi.org/10.1257/aer.99.4.1218>
- Besley, T., & Persson, T. (2010). State Capacity, Conflict, and Development. *Econometrica*, 78(1), 1–34. <https://doi.org/10.3982/ECTA8073>
- Besley, T., & Persson, T. (2011a). *Pillars of Prosperity: The Political Economics of Development Clusters*. Retrieved from https://books.google.com.gh/books?hl=en&lr=&id=N8hl2c5mIo0C&oi=fnd&pg=PP1&ots=5TyguVMYTh&sig=ohgdwFl_TfABLD7svDmH0Xh52qQ&redir_esc=y#v=onepage&q&f=false
- Besley, T., & Persson, T. (2011b). The logic of political violence. *Quarterly Journal of Economics*, 126(3), 1411–1445. <https://doi.org/10.1093/qje/qjr025>
- Besley, T., & Persson, T. (2013). Taxation and Development. In *Handbook of Public Economics* (Vol. 5). <https://doi.org/10.1016/B978-0-444-53759-1.00002-9>
- Besley, T., & Persson, T. (2014). Why Do Developing Countries Tax So Little? *Journal of Economic Perspectives*, 28(4), 99–120. <https://doi.org/10.1257/jep.28.4.99>
- Bhattacharyya, S., Conradie, L., & Arezki, R. (2017). Resource discovery and the politics of fiscal decentralization. *Journal of Comparative Economics*, 45(2), 366–382.
<https://doi.org/10.1016/j.jce.2017.02.003>
- Bhattacharyya, S., & Hodler, R. (2010). Natural resources, democracy and corruption.

- European Economic Review*, 54(4), 608–621.
<https://doi.org/10.1016/j.eurocorev.2009.10.004>
- Bhattacharyya, S., & Hodler, R. (2014). Do Natural Resource Revenues Hinder Financial Development? The Role of Political Institutions. *World Development*, 57, 101–113.
<https://doi.org/10.1016/j.worlddev.2013.12.003>
- Bhattacharyya, S., & Mamo, N. (2019). Natural Resources and Conflict in Africa: What Do the Data Show? *Economic Development and Cultural Change*, *forthcomin*.
<https://doi.org/10.1086/704513>
- Billor, N., Hadi, A. S., & Velleman, P. F. (2000). BACON: Blocked adaptive computationally efficient outlier nominators. *Computational Statistics and Data Analysis*, 34(3), 279–298.
[https://doi.org/10.1016/S0167-9473\(99\)00101-2](https://doi.org/10.1016/S0167-9473(99)00101-2)
- Bird, R. M., Martinez-Vazquez, J., & Torgler, B. (2008). Tax Effort in Developing Countries and High Income Countries: The Impact of Corruption, Voice and Accountability. *Economic Analysis and Policy*, 38(1), 55–71. [https://doi.org/10.1016/S0313-5926\(08\)50006-3](https://doi.org/10.1016/S0313-5926(08)50006-3)
- Bisin, A., & Verdier, T. (2017). *On the Joint Evolution of Culture and Institutions* (No. Working paper 23375). Retrieved from <http://www.nber.org/papers/w23375>
- Bjornland, H. C., & Thorsrud, L. A. (2016). Boom or Gloom? Examining the Dutch Disease in Two-speed Economies. *Economic Journal*, 126(598).
<https://doi.org/10.1111/econj.12302>
- Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade Induce Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity. *Review of Economic Studies*, 83, 87–117. <https://doi.org/10.3386/w16717>
- Bond, S. S., Hoeffler, A., & Temple, J. (2001). GMM estimation of empirical growth models. *Economics Papers, Economics Group, Nuffield College: University of Oxford*, W21(01),

33. [https://doi.org/10.1016/S0165-1765\(02\)00083-6](https://doi.org/10.1016/S0165-1765(02)00083-6)
- Borge, L.-E., Parmer, P., & Torvik, R. (2015). Local natural resource curse? *Journal of Public Economics*, 131, 101–114. <https://doi.org/10.1016/j.jpubeco.2015.09.002>
- Bornhorst, F., Gupta, S., & Thornton, J. (2009). Natural resource endowments and the domestic revenue effort. *European Journal of Political Economy*, 25(4), 439–446. <https://doi.org/10.1016/j.ejpoleco.2009.01.003>
- Boschini, A. D., Pettersson, J., & Roine, J. (2007). Resource curse or not: A question of appropriability. *Scandinavian Journal of Economics*, 109(3), 593–617. <https://doi.org/10.1111/j.1467-9442.2007.00509.x>
- Boschini, A., Pettersson, J., & Roine, J. (2013). The Resource Curse and its Potential Reversal. *World Development*, 43, 19–41. <https://doi.org/10.1016/j.worlddev.2012.10.007>
- Botlhole, T., Asafu-Adjaye, J., & Carmignani, F. (2012). Natural resource abundance, institutions and tax revenue mobilisation in sub-Sahara Africa. *South African Journal of Economics*, 80(2), 135–156. <https://doi.org/10.1111/j.1813-6982.2011.01305.x>
- Brautigam, D., Fjeldstad, O.-H., & Moore, M. (2008). *Taxation and state-building in developing countries: capacity and consent*. Retrieved from <https://open.cmi.no/cmi-xmlui/handle/11250/2475260>
- Brown, J. R., Cookson, J. A., & Heimer, R. Z. (2017). Courting economic development. *World Bank Economic Review*, 30, S176–S187. <https://doi.org/10.1093/wber/lhw027>
- Brunnschweiler, C. N. (2008). Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth. *World Development*, 36(3), 399–419. <https://doi.org/10.1016/j.worlddev.2007.03.004>
- Brunnschweiler, C. N., & Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of Environmental Economics and Management*, 55(3), 248–264. <https://doi.org/10.1016/j.jeem.2007.08.004>

- Bulte, E. H., Damania, R., & Deacon, R. T. (2005). Resource intensity, institutions, and development. *World Development*, 33(7), 1029–1044.
<https://doi.org/10.1016/j.worlddev.2005.04.004>
- Carmignani, F. (2013). Development outcomes, resource abundance, and the transmission through inequality. *Resource and Energy Economics*, 35(3), 412–428.
<https://doi.org/10.1016/J.RESENEECO.2013.04.007>
- Caselli, F., & Michaels, G. (2013). Do Oil Windfalls Improve Living Standards? Evidence from Brazil. *American Economic Journal: Applied Economics*, 5(1), 208–238.
<https://doi.org/10.1257/app.5.1.208>
- Caselli, F., & Tesei, A. (2016). Resource Windfalls, Political Regimes, and Political Stability. *Review of Economics and Statistics*, 98(3), 573–590.
https://doi.org/10.1162/REST_a_00538
- Chaudhry, K. A. (1997). The Price of Wealth: Economies and Institutions in the Middle East - Kiren Aziz Chaudhry - Google Books. In *Cornell University Press*. Retrieved from https://books.google.com.gh/books?hl=en&lr=&id=OjFhOQMek4oC&oi=fnd&pg=PR9&ots=ua7RqRWXgs&sig=o_yYP6xjHJPyc1JmkIXH9IcnWY&redir_esc=y#v=onepage&q&f=false
- Clemens, M. A., & Postel, H. M. (2018). *Deterring Emigration with Foreign Aid : An Overview of Countries CGD Policy Paper 119 February 2018*. (February).
- Clist, P. (2016). Foreign aid and domestic taxation: Multiple sources, one conclusion. *Development Policy Review*, 34(3), 365–383. <https://doi.org/10.1111/dpr.12154>
- Coase, R. H. (1960). The Booth School of Business of the University of Chicago The University of Chicago Law School The University of Chicago. *Journal of Law and Economics*, 3(October), 1–44.
- Cockx, L., & Francken, N. (2016). Natural resources: A curse on education spending? *Energy*

- Policy*, 92, 394–408. <https://doi.org/10.1016/J.ENPOL.2016.02.027>
- Collier, P. (2017). The Institutional and Psychological Foundations of Natural Resource Policies. *Journal of Development Studies*, 53(2), 217–228. <https://doi.org/10.1080/00220388.2016.1160067>
- Collier, P., & Goderis, B. (2009). Commodity prices, growth, and the natural resource curse: reconciling a conundrum. In *Oxford Economic Papers*. <https://doi.org/10.2139/ssrn.1473716>
- Collier, P., & Hoeffler, A. (2009). Testing the neocon agenda: Democracy in resource-rich societies. *European Economic Review*, 53(3), 293–308. <https://doi.org/10.1016/j.euroecorev.2008.05.006>
- Corden, W. M. (1984). Booming Sector and Dutch Disease Economics: Survey and Consolidation. *Oxford Economic Papers, New Series*, 36(3), 359–380. Retrieved from <http://www.jstor.org/stable/2662669>
- Corden, W. M., & Neary, J. P. (1982a). *Booming Sector and De-Industrialisation in a Small Open Economy* Published by: Wiley on behalf of the Royal Economic Society Stable URL : <http://www.jstor.org/stable/2232670> Accessed : 10-03-2016 14 : 57 UTC Your use of the JSTOR archive indicates your ac. 92(368), 825–848.
- Corden, W. M., & Neary, J. P. (1982b). Booming Sector and De-Industrialization in a Small Open Economy. *The Economic Journal*, 92(No. 368), 825–848. <https://doi.org/10.1109/TDEI.2009.5211872>
- Crivelli, E., & Gupta, S. (2014). Resource blessing, revenue curse? Domestic revenue effort in resource-rich countries. *European Journal of Political Economy*, 35. <https://doi.org/10.1016/j.ejpoleco.2014.04.001>
- Cruz, C., Keefer, P., & Scartascini, C. (2016a). *Database of Political Institutions 2015: Codebook* (Vol. 176).

- Cruz, C., Keefer, P., & Scartascini, C. (2016b). *Database of Political Institutions 2015: Codebook* (Vol. 176). Inter-American Development Bank.
- Daniel, P., Keen, M., & McPherson, C. P. (2010). *The Taxation of Petroleum and Minerals Principles Problems and Practice*. Routledge/International Monetary Fund.
- Dauvin, M., & Guerreiro, D. (2017). The Paradox of Plenty: A Meta-Analysis. *World Development*. <https://doi.org/10.1016/j.worlddev.2017.01.009>
- Deacon, R. T. (2011). The Political Economy of the Natural Resource Curse: a Survey of Theory and Evidence, Foundation and Trends in Microeconomics. In *Microeconomics* (Vol. 7). Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:No+Title#0>
- Diamond, P. A., & Mirrlees, J. A. (1971). Optimal Taxation and Public Production I: Production Efficiency. *American Economic Review*, 61(1), 8–27. <https://doi.org/10.2307/2296446>
- Dietz, S., Neumayer, E., & De Soysa, I. (2007). Corruption, the resource curse and genuine saving. *Environment and Development Economics*, 12(1), 33–53. <https://doi.org/10.1017/s1355770x06003378>
- Djankov, S., La Porta, R., Lopez-De-Silanes, F., & Shleifer, A. (2003). Courts. *Quarterly Journal of Economics*, (May).
- Drummond, P., Srivastava, N., Daal, W., & Oliveira, L. E. (2012). Mobilizing Revenue in Sub-Saharan Africa: Empirical Norms and Key Determinants. *IMF Working Papers*, 12/108, 42 pages. Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=ec&AN=1311243>
- Edwards, R. B. (2016). Mining away the Preston curve. *World Development*, 78, 22–36. <https://doi.org/10.1016/J.WORLDDEV.2015.10.013>

- Efendic, A., Pugh, G., & Adnett, N. (2011). Institutions and economic performance: A meta-regression analysis. *European Journal of Political Economy*, 27(3), 586–599. <https://doi.org/10.1016/j.ejpoleco.2010.12.003>
- El Anshasy, A. A., & Katsaiti, M. S. (2013). Natural resources and fiscal performance: Does good governance matter? *Journal of Macroeconomics*, 37, 285–298. <https://doi.org/10.1016/j.jmacro.2013.05.006>
- Erbil, N. (2011). Is Fiscal Policy Procyclical in Developing Oil-Producing Countries? *International Monetary Fund, IMF Working Papers: 11/171, 2011, 32 Pp.*, 32-. Retrieved from <http://search.proquest.com/docview/896015208?accountid=17248>
- Eregha, P. B., & Mesagan, E. P. (2016). Oil resource abundance, institutions and growth: Evidence from oil producing African countries. *Journal of Policy Modeling*, 38(3), 603–619. <https://doi.org/10.1016/j.jpolmod.2016.03.013>
- Fearon, J. D., & Laitin, D. D. (2003). Ethnicity, Insurgency, and Civil War. *American Political Science Review*, 97(1), 75–90. Retrieved from <https://web.stanford.edu/group/ethnic/workingpapers/Datapap1.pdf>
- Flachaire, E., Garcia-Peñalosa, C., & Konte, M. (2014). Political versus economic institutions in the growth process. *Journal of Comparative Economics*, 42(1), 212–229. <https://doi.org/10.1016/j.jce.2013.05.001>
- Forstater, M. (2018). *Frontiers of Research and Action CGD Policy Paper 118 February 2018*. (February), 1–49.
- Foster, V., Butterfield, W., Chen, C., & Pushak, N. (2008). Building bridges: China's growing role as infrastructure financier for Sub-Saharan Africa. In *Trends and Policy Options*. <https://doi.org/10.1111/j.1365-313X.2011.04497.x>
- Fosu, A. K. (2008). *Democracy and growth in Africa : Implications of increasing electoral competitiveness*. 100, 442–444. <https://doi.org/10.1016/j.econlet.2008.03.016>

- Fosu, A. K. (2011). *CSAE Working Paper WPS / 2011-09*. (March), 4–5.
- Fosu, A. K. (2013a). Achieving Development Success. In A. K. Fosu (Ed.), *Achieving Development Success*. <https://doi.org/10.1093/acprof:oso/9780199671557.001.0001>
- Fosu, A. K. (2013b). Growth of african economies: Productivity, policy syndromes and the importance of institutions. *Journal of African Economies*, 22(4), 523–551. <https://doi.org/10.1093/jae/ejs034>
- Fosu, A. K. (2017). *Institutions and African Economic Development: A Concise Review*. (April 2015), 1–22.
- Frankel, J. A. (2012). The Natural Resource Curse : A Survey of Diagnoses and Some Prescriptions. In *HKS Faculty Research Working Paper Series RWP12-014*. Retrieved from <http://web.hks.harvard.edu/publications/citation.aspx?PubId=8331>
- Freiden, J. A. (1991). *Debt, Development, and Democracy: Modern Political Economy and Latin America ...* Retrieved from <https://books.google.com.gh/books?hl=en&lr=&id=DtTiCy7z7zMC&oi=fnd&pg=PR7&dq=Frieden,+Jeffrey+A.+1992.+Debt,+Development,+and+Democracy:+Modern+Political+Economy+and+Latin+America,+1965–1985.+Princeton,+N.J.:+Princeton+University+Press.&ots=oDtKve>
- Fum, R. M., & Hodler, R. (2010). Natural resources and income inequality: The role of ethnic divisions. *Economics Letters*, 107(3), 360–363. <https://doi.org/10.1016/J.ECONLET.2010.03.008>
- Ghura, D. (1998). *Tax Revenue in Sub-Saharan Africa: Effects of Economic Policies and Corruption - Mr. Dhaneshwar Ghura - Google Books*. Retrieved from [https://books.google.com.gh/books?hl=en&lr=&id=wzjZHcFjBLoC&oi=fnd&pg=PA1987&dq=Ghura,+D.+\(1998\).+Tax+revenue+in+sub-Saharan+Africa:+Effects+of+economic+policies+and+corruption.+IMF+Working+Pape](https://books.google.com.gh/books?hl=en&lr=&id=wzjZHcFjBLoC&oi=fnd&pg=PA1987&dq=Ghura,+D.+(1998).+Tax+revenue+in+sub-Saharan+Africa:+Effects+of+economic+policies+and+corruption.+IMF+Working+Pape)

r+98/135+(Washington:+International+Monetary+Fund).&ots=5kp3q

- Glaeser, E. L. ., Porta, R. La, Lopez-De-Silanes, F., & Shleifer, A. (2004). Do Institutions Cause Growth? *Journal of Economic Growth*, 9(3), 271–303. Retrieved from <https://www.jstor.org/stable/40215873> Do Institutions Cause Growth ?
- Glaeser, E. L. ., & Shleifer, A. (2002). Legal origins. *Quarterly Journal of Economics*, (November).
- Grafe, R., & Gelderblom, O. (2010). The Rise and Fall of the Merchant Guilds : Re-thinking the Comparative Study of Commercial Institutions in Premodern Europe. *The Journal of Interdisciplinary History*, 40(4), 477–511. Retrieved from <https://www.jstor.org/stable/20685545>
- Greif, A. (1998). *American Economic Association Historical and Comparative Institutional Analysis Author (s) : Avner Greif Source : The American Economic Review , Vol . 88 , No . 2 , Papers and Proceedings of the Hundred and Tenth Annual Meeting of the American Economic A. 88(2).*
- Greif, A. (2006). *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. <https://doi.org/10.3917/rpec.102.0121>
- Gupta, Abhijit, S. (2007). *Determinants of Tax Revenue Efforts in Developing Countries - Abhijit Sen Gupta - Google Books* (No. 07/184). Retrieved from [https://books.google.com.gh/books?hl=en&lr=&id=egZUr8Ial4kC&oi=fnd&pg=PA3&dq=Sen+Gupta,+A.+\(2007\).+Determinants+of+tax+revenue+efforts+in+developing+countries,+IMF+Working+Paper+07/184,+Washington:+International+Monetary+Fund.&ots=EmuDwluR0S&sig=SiDYPjIPP](https://books.google.com.gh/books?hl=en&lr=&id=egZUr8Ial4kC&oi=fnd&pg=PA3&dq=Sen+Gupta,+A.+(2007).+Determinants+of+tax+revenue+efforts+in+developing+countries,+IMF+Working+Paper+07/184,+Washington:+International+Monetary+Fund.&ots=EmuDwluR0S&sig=SiDYPjIPP)
- Gupta, S., & Tareq, S. (2008). Mobilizing revenue. *Finance and Development*, 45(3), 44–47.
- Gupta, A. Sen. (2007). Determinants of Tax Revenue Efforts in Developing Countries. *IMF Working Papers*, 07(184), 1. <https://doi.org/10.5089/9781451867480.001>

- Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review*, 45(4–6), 847–859. [https://doi.org/10.1016/S0014-2921\(01\)00127-1](https://doi.org/10.1016/S0014-2921(01)00127-1)
- Haber, S., & Menaldo, V. (2011). Do Natural Resources Fuel Authoritarianism? A Preappraisal of the Resource Curse. *American Political Science Review*, 105(1), 1–26. <https://doi.org/10.1017/S0003055410000584>
- Hagen, Jürgen von. (2003). *Political Economy of Fiscal Autonomy*. 49(149), 4213–4216.
- Hall, R., & Jones, C. (1999). *Why Do Some Countries Produce So Much More Output per Worker than Others?* (February), 83–116. <https://doi.org/10.3386/w6564>
- Halland, H., Beardsworth, J., Land, B., & Schmidt, J. (2014). *Resource Financed Infrastructure: A discussion on a new form of infrastructure financing*. <https://doi.org/10.1596/978-1-4648-0239-3>
- Hamdi, H., & Sbia, R. (2013). Dynamic relationships between oil revenues, government spending and economic growth in an oil-dependent economy. *Economic Modelling*, 35, 118–125. <https://doi.org/10.1016/j.econmod.2013.06.043>
- Hausman, J A. (1978). Specification Tests in Econometrics. *Econometrica*, 46(46), 1251–1271. Retrieved from <http://www.jstor.org/stable/1913827> <http://about.jstor.org/terms>
- Hausman, Jerry A., & Taylor, W. E. (1981). Panel Data and Unobservable Individual Effects. *Econometrica*, 49(6), 1377–1398.
- Hausmann, R., & Rigobon, R. (2002). *An Alternative Interpretation of the Resource Curse: Theory and Policy Implications* (No. 9424). Cambridge, MA.
- Henry, A. (2019). Transmission channels of the resource curse in Africa: A time perspective. *Economic Modelling*. <https://doi.org/10.1016/j.econmod.2019.05.022>
- Hindriks, F., & Guala, F. (2015). Institutions, rules, and equilibria: A unified theory. *Journal of Institutional Economics*, 11(3), 459–480. <https://doi.org/10.1017/S1744137414000496>
- Hodgson, G. M. (2004). *The Evolution of Institutional Economics: Agency, Structure and*

- Darwinism in American Institutionalism* (First). New York: Routledge.
- Hodgson, G. M. (2015). On defining institutions: Rules versus equilibria. *Journal of Institutional Economics*, 11(3), 497–505. <https://doi.org/10.1017/S1744137415000028>
- Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating Vector Autoregressions with Panel Data Author (s): Douglas Holtz-Eakin , Whitney Newey and Harvey S . Rosen Reviewed work (s): Published by: The Econometric Society Stable URL : <http://www.jstor.org/stable/1913103> . *Econometrica*, 56(6), 1371–1395.
- Hu, A. G., & Jefferson, G. H. (2009). A great wall of patents: What is behind China’s recent patent explosion? *Journal of Development Economics*, 90(1), 57–68. <https://doi.org/10.1016/J.JDEVECO.2008.11.004>
- Humphreys, M. (2005). Natural resources, conflict, and conflict resolution: Uncovering the mechanisms. *Journal of Conflict Resolution*, 49(4), 508–537. <https://doi.org/10.1177/0022002705277545>
- International Energy Agency. (2017). *World Energy Outlook*.
- International Monetary Fund. (2015). The Taxation of Petroleum and Minerals. In *The Taxation of Petroleum and Minerals*. <https://doi.org/10.5089/9780415781381.071>
- International Monetary Fund. (2016). *World Economic Outlook*. Retrieved from <https://www.imf.org/en/Publications/WEO/Issues/2018/01/11/world-economic-outlook-update-january-2018>
- Isham, J., Woolcock, M., Pritchett, L., & Busby, G. (2005). The varieties of resource experience: Natural resource export structures and the political economy of economic growth. *World Bank Economic Review*, 19(2), 141–174. <https://doi.org/10.1093/wber/lhi010>
- Jensen, A. D. (2011). State-Building in Resource-Rich Economies. *Atlantic Economic Journal*, (June), 171–193. <https://doi.org/10.1007/s11293-011-9269-z>

- Johnson, S., McMillan, J., & Woodruff, C. (2002a). *Property Rights and Finance* (No. 8852). Retrieved from <http://www.nber.org/papers/w8852.pdf&hl=en&sa=T&oi=gsb-gga&ct=res&cd=0&d=14133695006392590353&ei=Gx81XN33G9KTmwHz7qDYBg&scisig=AAGBfm0kuXApIwQaEn6Q1CbR1yJJyzEIww>
- Johnson, S., McMillan, J., & Woodruff, C. M. (2002b). Courts and Relational Contracts. *Journal of Law, Economics and Organization*, 18(1), 221–277. <https://doi.org/10.2139/ssrn.291802>
- Joshi, A., Prichard, W., & Heady, C. (2014). Taxing the Informal Economy: The Current State of Knowledge and Agendas for Future Research. *Journal of Development Studies*, 50(10), 1325–1347. <https://doi.org/10.1080/00220388.2014.940910>
- Kaldor, N. (1963). Taxation for economic development. *The Journal of Modern African Studies*, 1(01), 7–23. <https://doi.org/10.1017/S0001972000064846>
- Karimu, A., Adu, G., Marbuah, G., Mensah, J. T., & Amuakwa-Mensah, F. (2017). Natural Resource Revenues and Public Investment in Resource-rich Economies in Sub-Saharan Africa. *Review of Development Economics*, 21(4), e107–e130. <https://doi.org/10.1111/rode.12313>
- Karl, T. L. (1997). *The paradox of plenty : oil booms and petro-states*. University of California Press.
- Keen, M., & Mansour, M. (2009). *Revenue Mobilization in Sub-Saharan Africa : Challenges from Globalization* (No. 09/157).
- Kilian, L., & Hicks, B. (2013). *Did Unexpectedly Strong Economic Growth Cause the Oil Price Shock of 2003 – 2008 ?* 394(April 2012), 385–394.
- Klein, N. (2010). The Linkage between the Oil and Non-oil Sectors: A Panel VAR Approach. *IMF Working Papers*, 10(118), 1. <https://doi.org/10.5089/9781455200771.001>
- Klomp, J., & de Haan, J. (2016). Election cycles in natural resource rents: Empirical evidence.

- Journal of Development Economics*, 121, 79–93.
<https://doi.org/10.1016/j.jdeveco.2016.03.002>
- Klosek, K. C. (2018). The Extractive Industries and Society Catalysts of violence : How do natural resource extractive technologies in fl uence civil war outbreak and incidence in sub-Saharan Africa ? *The Extractive Industries and Society*, (February), 0–1.
<https://doi.org/10.1016/j.exis.2018.02.003>
- Knack, S. (2009a). Sovereign rents and quality of tax policy and administration. *Journal of Comparative Economics*, 37(3), 359–371. <https://doi.org/10.1016/j.jce.2009.04.001>
- Knack, S. (2009b). Sovereign rents and quality of tax policy and administration. *Journal of Comparative Economics*, 37(3), 359–371. <https://doi.org/10.1016/j.jce.2009.04.001>
- Knebelmann, J. (2017). *WIDER Working Paper 2017 / 10 Natural resources ' impact on government revenues*.
- Knutsen, C. H., Kotsadam, A., Olsen, E. H., & Wig, T. (2017). Mining and Local Corruption in Africa. *American Journal of Political Science*, 61(2), 320–334.
<https://doi.org/10.1111/ajps.12268>
- Koh, W. C. (2017). Fiscal Policy in Oil-exporting Countries: The Roles of Oil Funds and Institutional Quality. *Review of Development Economics*, 21(3), 567–590.
<https://doi.org/10.1111/rode.12293>
- Kolstad, I. (2009). The resource curse: which institutions matter? *Applied Economics Letters*, 16(4), 439–442. <https://doi.org/10.1080/17446540802167339>
- La Porta, R., López-de-Silanes, F., Pop-Eleches, C., & Shleifer, A. (2004). Judicial Checks and Balances. *Journal of Political Economy*, 112(2), 445–470.
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1998). Law and Finance. *Journal of Political Economy*, 106(6), 11131–11155. <https://doi.org/10.1086/250042>
- La Porta, R., Lopez-De-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal Determinants

- of External Finance. *The Journal of Finance*, 52(3), 1131–1150.
<https://doi.org/10.1111/j.1540-6261.1997.tb02727.x>
- Lederman, D., & Maloney, W. F. (2007). *Natural resources Neither Curse nor Destiny*.
https://doi.org/10.1007/SpringerReference_5860
- Leite, C., & Weidmann, J. (1999). *Does mother nature corrupt? Natural Resources, Corruption and Economic Growth* (No. WP/99/85). Washington DC.
- Lessmann, C., & Steinkraus, A. (2019). The geography of natural resources, ethnic inequality and civil conflicts. *European Journal of Political Economy*.
<https://doi.org/10.1016/j.ejpoleco.2019.01.005>
- Lin, J. Y., & Wang, Y. (2016). New Structural Economics and Resource Financed Infrastructure. *Pacific Economic Review*, 21(1), 102–117. <https://doi.org/10.1111/1468-0106.12154>
- Lotz, J. R., Morss, E. R., & Finance, P. (1965). *Measuring " Tax Effort " in Developing Countries*. 26(26), 478–479.
- Mahdavi, S. (2008). The level and composition of tax revenue in developing countries: Evidence from unbalanced panel data. *International Review of Economics and Finance*, 17(4), 607–617. <https://doi.org/10.1016/j.iref.2008.01.001>
- Mamo, N., Bhattacharyya, S., & Moradi, A. (2019). Intensive and extensive margins of mining and development: Evidence from Sub-Saharan Africa. *Journal of Development Economics*, 139(October 2018), 28–49. <https://doi.org/10.1016/j.jdeveco.2019.02.001>
- Marshall, M. G., Gurr, T. R., & Jagers, K. (2016). Polity IV Project Dataset Users' Manual, v.2015. *Polity IV Project*, 1–86. <https://doi.org/10.1177/0738894213499673>
- Mascagni, G. (2016). Aid and Taxation in Ethiopia. *The Journal of Development Studies*, 52(12), 1744–1758. <https://doi.org/10.1080/00220388.2016.1153070>
- Masi, T., Savoia, A., & Sen, K. (2018). *Is there a fiscal resource curse ? institutions*. Retrieved

from www.effective-states.org

- Mawejje, J. (2019). Natural resources governance and tax revenue mobilization in sub saharan Africa: The role of EITI. *Resources Policy*, 62(April), 176–183. <https://doi.org/10.1016/j.resourpol.2019.04.001>
- Mbu, A., & Tagem, E. (n.d.). *Aid, Taxes and Government Spending: a Heterogeneous, Cointegrated Panel Analysis*. (2015111).
- McGuirk, E. F. (2013). The illusory leader: Natural resources, taxation and accountability. *Public Choice*, 154(3–4). <https://doi.org/10.1007/s11127-011-9820-0>
- McNabb, K. (2017). *WIDER Working Paper 2017 / 184 Toward closer cohesion of international tax statistics*. (November).
- Mehlum, H., Moene, K., & Torvik, R. (2006). *Institutions and the Resource Curse* *. 116(2001), 1–20.
- Miller, M., Toffolutti, V., & Reeves, A. (2018). The enduring influence of institutions on universal health coverage: An empirical investigation of 62 former colonies. *World Development*, 111, 270–287. <https://doi.org/10.1016/J.WORLDDEV.2018.07.010>
- Mlachila, M., & Ouedraogo, R. (2017). Financial Development Resource Curse in Resource-Rich Countries: The Role of Commodity Price Shocks. *IMF Working Paper*. Retrieved from <https://www.imf.org/en/Publications/WP/Issues/2017/07/19/Financial-Resource-Curse-in-Resource-Rich-Countries-44938>
- Mohtadi, H., Ross, M. L., & Ruediger, S. (2016). *Oil , Taxation and Transparency* (Vol. 55108).
- Moore, M. (2007). *How does taxation affect the quality of governance?* Retrieved from <https://opendocs.ids.ac.uk/opendocs/handle/123456789/4044>
- Morrissey, O. (2015). Aid and domestic resource mobilization with a focus on Sub-Saharan Africa. *Oxford Review of Economic Policy*, 31(3–4), 447–461.

<https://doi.org/10.1093/oxrep/grv029>

- Nakyea, A. A., & Amoh, J. K. (2018). Have the generous tax incentives in the natural resource sector been commensurate with FDI flows? A critical analysis from an emerging economy. *International Journal of Critical Accounting*, 10(3/4), 257. <https://doi.org/10.1504/ijca.2018.093064>
- Ndikumana, L., & Abderrahim, K. (2010). Revenue mobilization in African countries: Does natural resource endowment matter? *African Development Review*, 22(3), 351–365. <https://doi.org/10.1111/j.1467-8268.2010.00250.x>
- Neudorfer, N. S. (2018). Commodities and corruption – How the middle class and democratic institutions lead to less corruption in resource-rich countries. *Resources Policy*. <https://doi.org/10.1016/j.resourpol.2018.05.003>
- North, D. C. (1986). The New Institutional Economics. *Journal of Institutional and Theoretical Economics*, 142(1), 230–237.
- North, D. C. (1990). *Institutions, Institutional Change And Economic Performance*. <https://doi.org/10.1017/CBO9780511606892.012>
- North, D. C. (1991). Institutions. *The Journal of Economic Perspectives*, 5(1), 97–112.
- Olson, M. (1993). Dictatorship, Democracy, and Development. *American Political Science Review*, 87(03), 567–576. <https://doi.org/10.2307/2938736>
- Omgba, L. D. (2009). On the Duration of Political Power in Africa. *Comparative Political Studies*, 42(3), 416–436. <https://doi.org/10.1177/0010414008325575>
- Omgba, L. D. (2016). *WIDER Working Paper 2016 / 154 On the mobilization of domestic resources in oil countries The role of historical factors Luc Désiré Omgba **. (December).
- OPEC. (2017). World Oil Outlook. In *The Leading Edge* (Vol. 4). <https://doi.org/10.1190/1.1439163>
- Osafo-Kwaako, P., & Robinson, J. A. (2013). Political centralization in pre-colonial Africa.

- Journal of Comparative Economics*, 41(1), 6–21.
<https://doi.org/10.1016/J.JCE.2013.01.003>
- Osei-Assibey, E., Domfeh, K. O., & Danquah, M. (2018). Corruption , institutions and capital flight : evidence from Sub-Saharan Africa. *Journal of Economic Studies*.
<https://doi.org/10.1108/JES-10-2016-0212>
- Ossowski, R., & Gonzales, A. (2012). Manna From Heaven. *IDB Working Paper Series No. ID-WP-337*, (August).
- Ostrom, E. (1986). An Agenda for the Study of Institutions. *Public Choice*, 48(1), 3–25.
- Parcerro, O. J., & Papyrakis, E. (2016). Income inequality and the oil resource curse. *Resource and Energy Economics*, 45, 159–177.
<https://doi.org/10.1016/J.RESENEECO.2016.06.001>
- Parente, P. M. D. C., & Santos Silva, J. M. C. (2012). A cautionary note on tests of overidentifying restrictions. *Economics Letters*, 115(2), 314–317.
<https://doi.org/10.1016/J.ECONLET.2011.12.047>
- Petermann, A., Guzmán, J. I., & Tilton, J. E. (2007). Mining and corruption. *Resources Policy*, 32(3), 91–103. <https://doi.org/10.1016/j.resourpol.2007.08.003>
- Poelhekke, S., & van der Ploeg, F. (2013). Do Natural Resources Attract Nonresource FDI? *Review of Economics and Statistics*, 95(3). https://doi.org/10.1162/REST_a_00292
- Political Risk Services. (2015). International Country Risk Guide Methodology. In *Country Reports*. <https://doi.org/hdl/1902.1/21446>
- Pomeranz, D., & Vila-Belda, J. (2019). Taking State-Capacity Research to the Field: Insights from Collaborations with Tax Authorities. *Annual Review of Economics*, 11(1), annurev-economics-080218-030312. <https://doi.org/10.1146/annurev-economics-080218-030312>
- Porta, R. La, Lopez-de-Silanes, F., & Shleifer, A. (2008). The Economic Consequences of Legal Origins. *Journal of Economic Literature*, 46(2), 285–332.

<https://doi.org/10.1257/jel.46.2.285>

- Prichard, W. (2016). Reassessing Tax and Development Research: A New Dataset, New Findings, and Lessons for Research. *World Development*, 80, 48–60. <https://doi.org/10.1016/j.worlddev.2015.11.017>
- Prichard, W., Cobham, A., & Goodall, A. (2014). The ICTD Government Revenue Dataset. In *ICTD Working Paper*. <https://doi.org/10.2139/ssrn.2496442>
- Prichard, W., Salardi, P., & Segal, P. (2018). Taxation, non-tax revenue and democracy: New evidence using new cross-country data. *World Development*, 109, 295–312. <https://doi.org/10.1016/J.WORLDDEV.2018.05.014>
- Ramsey, F. P. (1927a). A Contribution to the Theory of Taxation. *The Economic Journal*, 37(145), 47–61.
- Ramsey, F. P. (1927b). *A Contribution to the Theory of Taxation* Author (s): F . P . Ramsey
Published by: Wiley on behalf of the Royal Economic Society Stable URL :
<http://www.jstor.org/stable/2222721> Accessed : 05-04-2016 07 : 59 UTC. 37(145), 47–61.
- Ratti, R. A., & Vespignani, J. L. (2016). Oil prices and global factor macroeconomic variables. *Energy Economics*, 59, 198–212. <https://doi.org/10.1016/J.ENERCO.2016.06.002>
- Readhead, A. (2018). What Mining Can Learn from Oil: A Study of Special Transfer Pricing Practices in the Oil Sector, and their Potential Application to Hard Rock Minerals. *Center for Global Development Policy Paper 128*, (July). Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/African_Economic_Outlook_2018_-_EN.pdf
- Reichl, C., Schatz, M., & Zsak, G. (2017). *WORLD MINING DATA* (Vol. 32). Vienna.
- Ricciuti, R., Savoia, A., & Sen, K. (2018). How do political institutions affect fiscal capacity ? Explaining taxation in. *Journal of Institutional Economics*, 1–30.

<https://doi.org/10.1017/S1744137418000097>

Riker, W. H. (1980). Implications from the Disequilibrium of Majority Rule for the Study of Institutions. *American Political Science Review*, 74(02), 432–446.

<https://doi.org/10.2307/1960638>

Rodrik, D. (2004). *Paper: Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development*.

Roodman, D. (2006). *How to Do xtabond2: An introduction to “Difference” and “System” GMM in Stata* (No. 125). Washington DC.

Roodman, D. (2008). *A Note on the Theme of Too Many Instruments* (No. 125). Washington DC.

Ross, M. (2008). *But seriously: does oil really hinder democracy*.

Sala-i-martin, X., & Subramanian, A. (2003). Addressing the Natural Resource Curse. *Nber Working Paper Series, No. 9804*(June), 46. <https://doi.org/10.1093/jae/ejs033>

Sala-i-Martin, X., & Subramanian, A. (2013). Addressing the natural resource curse: An illustration from Nigeria. *Journal of African Economies*, 22(4), 570–615. <https://doi.org/10.1093/jae/ejs033>

Sarmidi, T., Hook Law, S., & Jafari, Y. (2014). Resource Curse: New Evidence on the Role of Institutions. *International Economic Journal*, 28(1), 191–206. <https://doi.org/10.1080/10168737.2013.787110>

Sarr, M., & Wick, K. (2010). Resources, conflict and development choices: public good provision in resource rich economies. *Economics of Governance*, 11(2), 183–205. <https://doi.org/10.1007/s10101-010-0075-x>

Schotter, A. (1981). *The Economic Theory of Social Institutions*. Cambridge University Press.

Searle, J. R. (2005). What is an institution? *Journal of Institutional Economics*, 1(1), 1–22. <https://doi.org/10.1017/S1744137405000020>

- Smith, Benjamin. (2004). Oil Wealth and Political Survival in the Developing World, 1960-1999. *American Journal of Political Science*, 48 (2)(2), 232–246.
- Smith, Brock. (2015). The resource curse exorcised: Evidence from a panel of countries. *Journal of Development Economics*, 116, 57–73. <https://doi.org/10.1016/j.jdeveco.2015.04.001>
- Stijns, J.-P. C. (2000). Natural Resource Abundance and Economic Growth Revisited. *Resources Policy*, 30(2), 1–40. <https://doi.org/10.1016/j.resourpol.2005.05.001>
- Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business and Economic Statistics*, 20(4), 518–529. <https://doi.org/10.1198/073500102288618658>
- Studies, P., International, I. N., Deaton, A., Miller, R. O. N., & Section, I. F. (1995). *INTERNATIONAL COMMODITY PRICES , MACROECONOMIC PERFORMANCE , AND POLITICS IN SUB-SAHARAN AFRICA*.
- Szalai, L. (2018). Institutions and Resource-driven Development. *World Journal of Applied Economics*, 4(1), 39–53. <https://doi.org/10.22440/wjae.4.1.3>
- The World Bank. (2002). Building Institutions for Markets. In 感染症誌 (Vol. 91). Oxford University Press.
- Thomas, A. H., & Treviño, J. P. (2013). Resource Dependence and Fiscal Effort in Sub-Saharan Africa. *IMF Working Papers*, 13(188), i. <https://doi.org/10.5089/9781484391501.001>
- United Nations, N. Y. (2015). *Report of the third International Conference on Financing for Development* (Vol. 07583).
- United Nations, N. Y. (2019). *Bridging gaps or widening divides: Infrastructure development and structural transformation*. <https://doi.org/10.18356/74f4872a-en>
- Van Der Ploeg, F., & Poelhekke, S. (2017). The Impact of Natural Resources: Survey of Recent Quantitative Evidence. *Journal of Development Studies*, 53(2), 205–216.

<https://doi.org/10.1080/00220388.2016.1160069>

- Van der Ploeg, F., & Venables, A. J. (2013). Absorbing a windfall of foreign exchange: Dutch disease dynamics. *Journal of Development Economics*, 103(1), 229–243. <https://doi.org/10.1016/j.jdeveco.2013.03.001>
- Vasquez, P. (2018). *China, Oil and Latin America : MYTH VS . REALITY*. Washington DC.
- Venables, A. J. (2016a). Using Natural Resources for Development: Why Has It Proven So Difficult? *Journal of Economic Perspectives*. <https://doi.org/10.1257/jep.30.1.161>
- Venables, A. J. (2016b). Using Natural Resources for Development: Why Has It Proven So Difficult? *Journal of Economic Perspectives*, 30(1). <https://doi.org/10.1257/jep.30.1.161>
- Verbeek, M. (2004). A Guide to Modern Econometrics. In *Text* (2nd Editio). <https://doi.org/10.1017/CBO9781107415324.004>
- Villafuerte, M., & Lopez-Murphy, P. (2010). Fiscal Policy in Oil Producing Countries During the Recent Oil Price Cycle. *International Monetary Fund - Working Paper*, 23. Retrieved from <http://www.imf.org/external/pubs/cat/longres.aspx?sk=23592>
- Voigt, S. (2013). How (not) to measure institutions. *Journal of Institutional Economics*, 9(1), 1–26. <https://doi.org/10.1017/S1744137412000148>
- Von Haldenwang, C., & Ivanyna, M. (2018). Does The Political Resource Curse Affect Public Finance? The Vulnerability Of Tax Revenue In Resource-Dependent Countries. *Journal of International Economics*, 30, 323–344. Retrieved from <https://onlinelibrary.wiley.com/doi/pdf/10.1002/jid.3346>
- Weber, S. (2010). bacon: An effective way to detect outliers in multivariate data using Stata (and Mata). *The Stata Journal*, 10(3), 331–338. Retrieved from <http://www.stata-journal.com/article.html?article=st0197>
- Williams, A. (2011). Shining a Light on the Resource Curse: An Empirical Analysis of the Relationship Between Natural Resources, Transparency, and Economic Growth. *World*

- Development*, 39(4), 490–505. <https://doi.org/10.1016/j.worlddev.2010.08.015>
- Williamson, O. E. (2012). New Taking Institutional Economics : Ahead Looking. *Journal of Economic Literature*, 38(3), 595–613. <https://doi.org/10.1257/jel.38.3.595>
- Woldeyes, F. B. (2013). Long-Run Effects of Resource Rents in Developing Countries : The role of public investment management. *OxCarre Research Paper 105*, 44(0), 0–32.
- Wooldridge, J. M. (2001). Applications of Generalized Method of Moments Estimation. *The Journal of Economic Perspectives*, 15(4), 87–100. <https://doi.org/10.2307/2696518>
- World Bank. (2017). World development indicators 2017. In *World Bank*. Washington DC.
- World Bank Group, & EGPS. (2017). *The growing role of minerals and metals for a low carbon future*. (June), 112.
- Yanikkaya, H., & Turan, T. (2018). Curse or Blessing? An Empirical Re-examination of Natural Resource-Growth Nexus. *Journal of International Development*. <https://doi.org/10.1002/jid.3374>
- Zhang, Q., & Brouwer, R. (2019). Is China Affected by the Resource Curse? A Critical Review of the Chinese Literature. *Journal of Policy Modeling*. <https://doi.org/10.1016/j.jpolmod.2019.06.005>
- Zongwe, D. (2010). On the Road to Post Conflict Reconstruction by Contract: The Angola Model. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.1730442>

APPENDIX

APPENDIX A – CORRELATION MATRIX FOR INSTITUTIONAL VARIABLES

Pairwise Correlation Matrix for Institutional Variables												
	polity2	democ ed	exconst ed	liec	eiec	checks	bureacr	laworder	investprof	cpia_erm	cpia_prop	socioecon
polity2	1	0.962808	0.914309	0.688121	0.773627	0.671855	0.45636	0.278289	0.3642867	0.213995	0.29375	0.2158167
democ ed	0.962808	1	0.9478422	0.640327	0.714506	0.662841	0.539455	0.366658	0.4227533	0.241434	0.372421	0.3275907
exconst ed	0.914309	0.9478422	1	0.639703	0.701289	0.635677	0.537988	0.366806	0.4209464	0.224894	0.387992	0.3222399
liec	0.688121	0.6403271	0.639703	1	0.831023	0.597863	0.260018	0.15617	0.2581347	0.230805	0.210259	0.0588997
eiec	0.773627	0.714506	0.7012889	0.831023	1	0.699117	0.310156	0.166238	0.2709767	0.132592	0.155971	0.0784936
checks	0.671855	0.6628408	0.6356765	0.597863	0.699117	1	0.392203	0.262083	0.2385065	0.108148	0.144772	0.1632897
bureacr	0.45636	0.5394551	0.5379878	0.260018	0.310156	0.392203	1	0.670703	0.5181415	0.369591	0.288037	0.6812966
laworder	0.278289	0.3666584	0.3668058	0.15617	0.166238	0.262083	0.670703	1	0.4733396	0.318703	0.4518	0.6147097
investprof	0.364287	0.4227533	0.4209464	0.258135	0.270977	0.238507	0.518142	0.47334	1	0.221901	0.533055	0.5898354
cpia_erm	0.213995	0.2414343	0.2248936	0.230805	0.132592	0.108148	0.369591	0.318703	0.2219005	1	0.583861	0.3319195
cpia_prop	0.29375	0.3724207	0.3879915	0.210259	0.155971	0.144772	0.288037	0.4518	0.533055	0.583861	1	0.477618
socioecon	0.215817	0.3275907	0.3222399	0.0589	0.078494	0.16329	0.681297	0.61471	0.5898354	0.33192	0.477618	1

APPENDIX B – REGRESSION TABLES

Table 1 - Interactive Effect with Polity2 (10yr- average panel)

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1) OLS	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.112*** (0.0353)	-0.119** (0.0496)	-0.140*** (0.0517)	-0.138** (0.0669)	-0.267*** (0.0849)
polity2	0.220* (0.114)	0.0474 (0.114)	0.0490 (0.122)		
c.t_rent2gdp#c.polity2	0.00822 (0.00715)	0.00447 (0.00632)	0.00210 (0.00606)		
grants	0.227 (0.230)	0.373** (0.170)	0.333* (0.171)	0.348** (0.164)	0.289* (0.161)
corrupt	1.433*** (0.413)	0.403 (0.330)	0.629* (0.380)	0.655* (0.372)	0.725** (0.324)
agricval2GDP	0.0107 (0.0417)	-0.0230 (0.0368)	-0.0180 (0.0368)	-0.0204 (0.0375)	0.0124 (0.0374)
Log GDP per capita	1.433** (0.555)	2.122*** (0.584)	1.832*** (0.582)	1.750*** (0.589)	1.989*** (0.571)
trade2GDP2	0.00261 (0.00833)	0.00250 (0.00896)	0.000978 (0.00881)	0.000925 (0.00879)	0.00215 (0.00920)
democ_ed				0.111 (0.192)	
c.t_rent2gdp#c.democ_ed				-0.000370 (0.00849)	
eiec					-0.0948 (0.301)
c.t_rent2gdp#c.eiec					0.0232* (0.0123)
Country Effect	No	Yes	Yes	Yes	Yes
Time Effect	No	No	Yes	Yes	Yes
Observations	229	229	229	229	242
R-squared	0.463				
Number of id	95	95	95	95	99

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Long-run Interactive Effect with Other Political Institutions (10yr-average panel)

Dependent Variable: Non-resource tax effort as a percentage of GDP					
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE
t_rent2gdp	-0.113 (0.117)	0.227** (0.0972)	-0.226*** (0.0545)	-0.0975 (0.0740)	0.00688 (0.0752)
liec	0.517 (0.400)				
c.t_rent2gdp#c.liec	-0.00646 (0.0165)				
grants	0.298* (0.162)	0.442*** (0.116)	0.362** (0.142)	0.317** (0.158)	0.349*** (0.135)
corrupt	0.832*** (0.300)	0.569** (0.239)	0.711** (0.324)	0.644* (0.365)	0.596* (0.311)
agricval2GDP	-0.00273 (0.0381)	-0.0200 (0.0409)	-0.0122 (0.0370)	-0.0136 (0.0387)	-0.0147 (0.0435)
Log GDP per capita	1.635*** (0.569)	1.498*** (0.568)	1.883*** (0.584)	1.656*** (0.592)	1.647*** (0.575)
trade2GDP2	0.00567 (0.00931)	-0.00530 (0.00823)	0.00194 (0.00944)	0.00151 (0.00862)	-0.00524 (0.00793)
laworder		1.611*** (0.482)			
c.t_rent2gdp#c.laworder		-0.121*** (0.0270)			
checks			-0.570** (0.256)		
c.t_rent2gdp#c.checks			0.0303*** (0.0115)		
exconst_ed				0.526* (0.271)	
c.t_rent2gdp#c.exconst_ed				-0.00893 (0.0117)	
bureacr					1.097* (0.602)
c.t_rent2gdp#c.bureacr					-0.111*** (0.0419)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	242	246	242	229	246
Number of id	99	101	99	95	101

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Interactive Effect with Measures of Government Effectiveness (10yr-average panel)

Dependent Variable: Non-resource tax as a percentage of GDP				
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE
t_rent2gdp	0.0421 (0.0918)	-0.00540 (0.0787)	-0.688*** (0.224)	-0.376 (0.258)
investprof	-0.280 (0.277)			
c.t_rent2gdp#c.investprof	-0.0280** (0.0113)			
grants	0.435*** (0.151)	0.331** (0.148)	0.510*** (0.175)	0.467** (0.231)
corrupt	0.979*** (0.316)	0.793*** (0.298)	-1.261*** (0.485)	-1.034** (0.490)
agricval2GDP	-0.0242 (0.0439)	0.00253 (0.0442)	-0.0770* (0.0432)	-0.0635 (0.0528)
Log GDP per capita	1.955*** (0.621)	2.244*** (0.666)	1.258 (0.937)	1.244 (0.970)
trade2GDP2	0.00109 (0.00871)	-0.00394 (0.00860)	0.0691*** (0.0131)	0.0752*** (0.0157)
socioecon		0.00176 (0.296)		
c.t_rent2gdp#c.socioecon		-0.0334** (0.0145)		
cpia_erm			0.478 (1.103)	
c.t_rent2gdp#c.cpia_erm			0.158** (0.0728)	
cpia_prop				-0.609 (1.919)
c.t_rent2gdp#c.cpia_prop				0.0580 (0.0955)
Country Effect	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes
Observations	246	246	77	77
Number of id	101	101	45	45

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Interactive Effect: LICS and LMICS (10yr- average panel)

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE	(6) REE
t_rent2gdp	-0.125* (0.0655)	-0.129 (0.0899)	-0.0821 (0.0997)	0.0759 (0.130)	-0.0777 (0.101)	-0.105 (0.0722)
polity2	-0.0556 (0.129)					
c.t_rent2gdp#c.polity2	0.00266 (0.00841)					
grants	0.420** (0.174)	0.441** (0.175)	0.372** (0.158)	0.311* (0.163)	0.391** (0.165)	0.447*** (0.157)
corrupt	-0.625 (0.447)	-0.563 (0.411)	-0.570 (0.449)	-0.452 (0.382)	-0.494 (0.373)	-0.539 (0.474)
agricval2GDP	-0.0377 (0.0281)	-0.0364 (0.0289)	-0.0310 (0.0297)	-0.0268 (0.0278)	-0.0326 (0.0327)	-0.0471 (0.0309)
Log GDP per capita	1.693** (0.764)	1.654** (0.767)	1.552** (0.740)	1.019 (0.668)	1.502** (0.766)	1.578** (0.681)
trade2GDP2	0.0577*** (0.0125)	0.0594*** (0.0131)	0.0585*** (0.0116)	0.0658*** (0.0108)	0.0595*** (0.0127)	0.0590*** (0.0120)
democ_ed		-0.0706 (0.221)				
c.t_rent2gdp#c.democ_ed		-0.000703 (0.0152)				
eiec			0.252 (0.348)			
c.t_rent2gdp#c.eiec			-0.00719 (0.0129)			
liec				0.981*** (0.370)		

c.t_rent2gdp#c.liec				-0.0370**		
				(0.0181)		
exconst_ed					0.278	
					(0.312)	
c.t_rent2gdp#c.exconst_ed					-0.0132	
					(0.0185)	
checks						-0.138
						(0.378)
c.t_rent2gdp#c.checks						-0.00634
						(0.0117)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	113	113	113	113	113	113
Number of id	47	47	47	47	47	47

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 5: Interactive Effect with Other Political Institutions (LICs and LMICs -10year-average panel)

Dependent Variable: Non-resource tax as a percentage of GDP						
VARIABLES	(1) REE	(2) REE	(3) REE	(4) REE	(5) REE	(6) REE
t_rent2gdp	0.0970 (0.129)	-0.0707 (0.102)	0.0848 (0.0845)	-0.0663 (0.143)	-0.776** (0.325)	-0.367 (0.286)
laworder	1.476*** (0.499)					
c.t_rent2gdp#c.laworder	-0.108** (0.0426)					
grants	0.446*** (0.150)	0.428*** (0.152)	0.449*** (0.155)	0.399** (0.158)	0.471*** (0.171)	0.456** (0.227)
corrupt	-0.558 (0.343)	-0.686 (0.443)	-0.366 (0.336)	-0.736* (0.433)	-1.325*** (0.501)	-0.909* (0.506)
agricval2GDP	-0.0210 (0.0300)	-0.0253 (0.0310)	-0.0421 (0.0276)	-0.0374 (0.0282)	-0.104** (0.0449)	-0.0906* (0.0544)
Log GDP per capita	1.453** (0.595)	1.635** (0.708)	1.385* (0.741)	1.335** (0.680)	0.351 (0.766)	0.450 (0.848)
trade2GDP2	0.0647*** (0.00864)	0.0580*** (0.0125)	0.0688*** (0.0118)	0.0611*** (0.0107)	0.0717*** (0.0130)	0.0812*** (0.0151)
bureacr		0.957 (0.801)				
c.t_rent2gdp#c.bureacr		-0.0483 (0.0541)				
investprof			0.267 (0.279)			
c.t_rent2gdp#c.investprof			-0.0373*** (0.0119)			
socioecon				0.470 (0.379)		
c.t_rent2gdp#c.socioecon				-0.0180 (0.0284)		

cpia_erm					0.518	
					(1.494)	
c.t_rent2gdp#c.pia_erm					0.193*	
					(0.103)	
cpia_prop						-0.805
						(2.042)
c.t_rent2gdp#c.pia_prop						0.0619
						(0.110)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	113	113	113	113	68	68
Number of id	47	47	47	47	40	40

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Medium-Term Interactive Effect with Institutions Variables (LICs and LMICs: GMM on five-year average panel)

Dependent Variable: Non-resource tax as a percentage of GDP					
VARIABLES	(1)	(2)	(3)	(4)	(5)
L.tot_nrestax	0.492 (0.433)	0.595 (0.384)	0.0710 (1.125)	0.346 (0.319)	-0.0979 (1.336)
t_rent2gdp	-0.115 (0.116)	-0.0484 (0.152)	-0.121 (0.245)	0.0489 (0.258)	-0.162 (0.173)
polity2	-0.0265 (0.153)				
c.t_rent2gdp#c.polity2	0.00225 (0.00854)				
grants	0.199 (0.280)	0.112 (0.223)	0.356 (0.699)	0.132 (0.178)	0.342 (0.465)
corrupt	-1.000 (1.718)	-0.116 (1.338)	-1.627 (3.909)	-0.286 (1.181)	-2.007 (4.141)
agricval2GDP	-0.0740 (0.0526)	-0.0510 (0.0569)	-0.0870 (0.195)	-0.0628 (0.0438)	-0.0888 (0.140)
Log GDP per capita	-0.243 (1.050)	-0.0195 (1.242)	0.0677 (1.139)	0.0548 (0.975)	0.0323 (1.073)
trade2GDP2	0.0472 (0.0381)	0.0301 (0.0249)	0.0682 (0.0925)	0.0456* (0.0251)	0.0827 (0.104)
democ_ed		-0.0141 (0.258)			
c.t_rent2gdp#c.democ_ed		0.00523 (0.0124)			
eiec			0.136 (0.819)		
c.t_rent2gdp#c.eiec			-0.00728		

				(0.0252)	
liec				0.655	
				(0.841)	
c.t_rent2gdp#c.liec				-0.0226	
				(0.0390)	
checks					0.930
					(2.668)
c.t_rent2gdp#c.checks					-0.0202
					(0.0855)
Country Effects	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes
AR(1) P-Values	0.09	0.22	0.16	0.21	0.52
AR(2) P-Values	0.43	0.69	0.7	0.51	0.95
Hansen J (P-Values)	0.25	0.19	0.14	0.23	0.13
Number of Instruments	20	20	20	20	20
Observations	186	186	186	186	186
Number of id	44	44	44	44	44

Table 7: Medium-Term Interactive Effect with Institutions: LICs and LMICs (GMM on five-year average panel)

VARIABLES	Dependent Variable: Non-resource tax as a percentage of GDP				
	(1)	(2)	(3)	(4)	(5)
L.tot_nrestax	0.202 (0.570)	0.592 (0.384)	0.242 (0.382)	0.517 (0.402)	0.574 (0.379)
t_rent2gdp	-0.400 (0.833)	0.0427 (0.194)	-0.128 (0.197)	-0.0636 (0.240)	0.0160 (0.118)
laworder	-1.016 (3.278)				
c.t_rent2gdp#c.laworder	0.0478 (0.230)				
grants	0.402 (0.351)	0.156 (0.254)	0.385 (0.253)	0.239 (0.183)	0.0473 (0.204)
corrupt	-1.699 (2.797)	0.249 (0.794)	-0.776 (0.968)	-0.540 (1.116)	0.215 (1.192)
agricval2GDP	-0.0902 (0.0733)	-0.0775 (0.0910)	-0.0797 (0.0604)	-0.0428 (0.0473)	-0.0225 (0.0656)
Log GDP per capita	-0.169 (1.421)	0.145 (1.496)	-0.0612 (0.936)	0.118 (1.186)	-0.0987 (1.090)
trade2GDP2	0.0799 (0.0607)	0.0259 (0.0198)	0.0594** (0.0261)	0.0467* (0.0249)	0.0229 (0.0242)
bureacr		-0.447 (1.084)			
c.t_rent2gdp#c.bureacr		-0.0328 (0.0903)			
investprof			-0.311 (0.613)		
c.t_rent2gdp#c.investprof			-0.00663 (0.0262)		

socioecon				0.0369	
				(0.653)	
c.t_rent2gdp#c.socioecon				-0.0258	
				(0.0497)	
exconst_ed					0.453
					(0.405)
c.t_rent2gdp#c.exconst_ed					-0.00508
					(0.0156)
Country Effects	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes
AR(1) P-Values	0.21	0.28	0.17	0.19	0.2
AR(2) P-Values	0.46	0.93	0.6	0.43	0.66
Hansen J (P-Values)	0.3	0.17	0.06	0.43	0.2
Number of Instruments	20	20	20	20	20
Observations	186	186	186	186	186
Number of id	44	44	44	44	44

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 8: Robustness checks without outliers (using a Two-step Hadi procedure)

VARIABLES	(1)	(2)	(3)	(4)	(5)
t_rent2gdp	-0.0212 (0.0520)	-0.0688 (0.0783)	-0.0263 (0.0596)	0.00999 (0.0559)	-0.0540 (0.100)
polity2	-0.0178 (0.0606)				
c.t_rent2gdp#c.polity2	0.000401 (0.00658)				
grants	0.0271 (0.104)	0.00491 (0.104)	0.0259 (0.104)	0.0208 (0.0973)	0.00920 (0.0990)
corrupt	0.444 (0.297)	0.426 (0.298)	0.442 (0.294)	0.466* (0.238)	0.480** (0.231)
agricval2GDP	-0.0564 (0.0363)	-0.0520 (0.0360)	-0.0555 (0.0360)	-0.0635* (0.0357)	-0.0482 (0.0383)
Log GDP per capita	1.957*** (0.603)	1.897*** (0.565)	1.973*** (0.582)	1.824*** (0.605)	1.889*** (0.584)
exconst_ed		0.0402 (0.148)			
c.t_rent2gdp#c.exconst_ed		0.0122 (0.0191)			
democ_ed			-0.0316 (0.0959)		
c.t_rent2gdp#c.democ_ed			0.00139 (0.0112)		
checks				-0.0694 (0.0978)	
c.t_rent2gdp#c.checks				-0.0195 (0.0137)	

socioecon					-0.0772 (0.130)
c.t_rent2gdp#c.socioecon					0.00431 (0.0180)
Constant	0.613 (5.285)	0.745 (5.006)	0.568 (5.088)	1.305 (5.353)	0.684 (5.003)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	1,664	1,665	1,665	1,771	1,824
Number of id	90	90	90	94	96

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX C – LIST OF COUNTRIES

Name of Countries	Income Status
Burkina Faso; Ethiopia; Guinea; Liberia; Mali; Niger; Sierra Leone; Togo; Uganda; Zimbabwe;	Low Income Countries
Afghanistan, Chad, Haiti, Rwanda, South Sudan	
Bolivia; Cameroon; Congo, Rep.; Egypt, Arab Rep.; Ghana; India; Indonesia; Moldova; Nigeria; Pakistan; Papua New Guinea; Senegal; Sudan; Vietnam; Yemen Rep.; Zambia	Lower-Middle Income Countries
Cote d'Ivoire, Kiribati, Lao PDR, Mauritania, Micronesia Fed. St., Sao Tome & Principe, Syrian Arab Republic, Timor-Leste, Turkmenistan	
Algeria; Angola; Botswana; Bulgaria; Ecuador; Gabon; Iran, Islamic Rep.; Jamaica; Kazakhstan; Malaysia; Mongolia; Namibia; Paraguay, Romania, Serbia, Suriname, Thailand, Tunisia, Vanuatu, Yemen Rep.	Upper-Middle Income Countries
Azerbaijan, Belize, Bosnia and Herzegovina, Colombia, Dominica, Fiji, Grenada, Guatemala, Iraq, Libya, Mauritius, Mexico, Serbia, St. Vincent and the Grenadines, Tuvalu	
Bahrain, Brunei Darussalam, Chile, Croatia, Cyprus, Estonia, Hong Kong SAR (China), Iceland, Korea, Rep., Kuwait, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Slovenia, Sweden, Trinidad and Tobago, United States of America, Venezuela, RB	High-income Countries
Austria, Belgium, Canada, Czech Republic, Equatorial Guinea, Finland, France, Germany, Greece, Hungary, Israel, Ireland, Italy, Japan, Latvia, Portugal, Russian Federation, San Marino, Saudi Arabia, Slovak Republic, Switzerland, United Arab Emirates	

Source: Based on ICTD-GRD, 2017